MEMOIRS

OF THE

NATIONAL MUSEUM OF VICTORIA

MELBOURNE

(World List abbrev. Mem. Nat. Mus. Vic.)

No. 15

Issued October, 1947

R. T. M. PESCOTT, M.Agr.Sc., F.R.E.S.
DIRECTOR

PUBLISHED BY ORDER OF THE TRUSTEES

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NATIONAL MUSEUMS OF VICTORIA

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CONTENTS

NEW SPECIES OF THE GENERA PROLASIUS FOREL AND MELOPHORUS LUBBOCK (HYMENOPTERA, FORMICIDAE)

By J. J. McAreavey, S.J.

Plate 1, Fig. 1.

(Received for publication May 27, 1947)

Although this paper is concerned almost entirely with species of *Prolasius,* it is not meant to be a revision of that genus. Species described by Clark from the Otway Ranges (Mem. Nat. Mus. Vict. 8, pp. 66-70, 1934), and several species previously regarded as belonging to other genera, have been included as well as a number of new species. Since, however, only those new species of which considerable numbers of specimens could be examined are described in this paper, and since it is known that there are undescribed species in various collections, a complete revision of the genus *Prolasius* would contain more than twice the number of ants here described.

Wheeler included among *Prolasius* the species *Notoncus hickmani* Clark and *Notoncus rotundiceps* Clark (Roy. Soc. Vict. 42, pp. 126-127, 1929), though in his article (Psyche 42, March pp. 68-72, 1935) he does not give the reason for this change. This does not appear to be correct, since apart from the difference in the structure of the thorax, neither of these species has the ocelli, which are always present in *Prolasius.* However, from the descriptions and figures, neither of these species seem to belong to *Notoncus,* for the pronotum and metanotum lack the characteristics of that genus, and again ocelli should be present, as in other species of *Notoncus.* Without an examination of the types, it is difficult to determine to which genus these species should be transferred—certainly they are not *Prolasius.*

In the same article in Psyche, Wheeler agrees with Clark, who places the genus *Myrmecorhynchus* in the tribe *Melophorini,* though previously both he and Emery (Genera Insect. Fasc. 183, p. 36, 1925) had regarded it as representing a distinct tribe. *Melophorini* now contain the following almost entirely Australian genera—*Melophorus* Lubbock, *Prolasius* Forel, *Diodontolepis* Wheeler, *Notoncus* Emery, *Pseudonotoncus* Clark and *Myrmecorhynchus* Andre, each of which needs complete revision. Based on differences in external structure, Wheeler's division of

Melophorus into three sub-genera (Psyche 1935 p. 69) (i) *Melophorus sensu stricto,* (ii) *Erimelophorus* and (iii) *Trichomelophorus,* is a useful one. Further knowledge of the habits of the species may suggest an even more accurate division, for the habits certainly differ greatly—some species are honey ants, others harvest grain, and a third group, containing *Melophorus fulvihirtus* Clark, live by raiding other ant nests. The interesting ant, *Melophorus potteri* new species, described in this paper presents still another difference of habit, for this ant attacks termites.

The habits and nest of *M. potteri* correspond closely to those of the robber ant *M. fulvihirtus,* described by Clark (Mem. Nat. Mus. Vict. 12, pp. 71-74, 1941). It is interesting to note that the moundless nest, and the habit of closing the entrance with small stones during the cooler part of the day, is common to other species of *Melophorus. Melophorus aeneovirens* (Lowne) has been observed at Pymble, N.S.W., and it was noted that the entrance to the nest was open only from about eleven a.m. till three p.m. on hot days, and that the small stones used to close the entrance were kept inside the nest. The nest of *M. potteri* is situated about three or four yards from the termite nest, and when the temperature rises to above 90° Fahr. a few ants appear and make their way to the termite nest. To quote Mr. Herbert Potter, of Patho, Victoria, who discovered this species, "they break into the cast of the termite nest on the surface of the ground, enter, always come out backwards dragging the termites after them, and go into their own nests in the same way." "They are not very numerous, and there are not often more than three or four on the track between the two nests." "They seem to live entirely on termites and are never seen carrying anything else to their nests."

Wheeler, in his paper on the relationship between ants and termites (Proc. Amer. Acad. Arts and Sc. 71 (3) pp. 159-243, 1936), discusses at length the question of "Termitharpagy," but the habits of *M. potteri* do not appear to correspond with those of any ant he describes. *Stigmacros termitoxenus* Wheeler, for example, from Mullewa, W.A., lives in the nest of *Tumulitermes peracutus* Hill apparently quite peacefully, though it is possible that it steals termite eggs as do many of the species of *Solenopsis.* The Ponerine ants, *Termitopone* and *Megapone* of Brazil attack termite nests, and carry off termites, but they do this in close columns, rather similar to the raiding columns of our *Eusphinctus* when these carry off the eggs and larvæ of other ants. The Australian species *Machomyrma dispar* Forel engages in warfare

with termites, and it is a well known fact that *Iridomyrmex* and many Formicinæ attack termites once they discover a broken termite nest, but systematic raiding by individual ants appears to be something new.

Family **FORMICIDAE** Latreille, 1810
Subfamily **Formicinae** Lepeletier, 1836
Tribe Melophorini Forel, 1912
Genus PROLASIUS Forel, 1892

Genus PROLASIUS Florel, Mitt. Schweitz. Ent. Ges. 8. p. 332, 1892.

Formica (part) Smith Trans. Ent. Soc. Lond., I., p. 53, 1862.
Prenolepis (part) Mayr Verh. Zool. Bot. Ges Wien., 36, p. 362, 1886.
Lasius subgen. *Prolasius* Forel Mitt. Scheitz. Ent. Ges., 8, p. 332, 1892.
Melophorus subgen. *Lasiophanes* Emery Act. Soc. Sc. Chili, p. 16, 1895.
Prolasius Wheeler Bull. Amer. Mus. Nat. Hist., 45, p. 695, 1922.
Melophorus subgen. *Prolasius* Emery Genera Insect. fasc. 183, p. 13, 1925.
Prolasius Clark Mem. Nat. Mus. Vict., 8, p. 66, 1934.

Worker: small and *monomorphic.* Head subrectangular with sides more or less convex. Mandibles with the masticatory edge furnished with five or six small but distinct teeth; the *tips of the terminal edge do not cross* as they do on Pseudolasius. Frontal carinæ short and straight. The *antennal groove does not merge completely with the clypeal groove.* Antennæ of twelve segments with the funiculus filiform. Frontal area distinct. Eyes moderately large. Ocelli always present. Thorax more or less constricted at the mesonotal region, and both sutures are distinct. Epinotum more or less convex above and quite unarmed. *Node perpendicular,* not sloping. Gaster oval. Legs usually slender.

Female and male distinguished by the same characters as in the worker. The wings have a closed radial cell without a discoidal cell. In the male the outer genital plates are triangular, but very much narrower towards the tip, the middle plates have a short blunt outer, and a long hook-shaped inner process.

Pupæ enclosed in cocoons.

Type *Prolasius advena* Smith.

KEY TO SPECIES

A. Uniformly light brown.

Clypeus carinated.

1. Declivity of epinotum twice as long as the dorsum — *P. advena* Smith.
2. Declivity of epinotum three times as long as the dorsum — *P. hellenae* new sp.
3. Declivity of epinotum slightly longer than the dorsum — *P. antennata* new sp.

Clypeus not carinated.

4. Anterior border of clypeus rounded and the declivity of the epinotum twice as long as the dorsum — *P. zealandica* Smith.
5. Anterior border of clypeus rounded and the declivity of the epinotum one quarter longer than the dorsum — *P. convexa* new sp.
6. Anterior border of clypeus produced to a blunt point and the first segment of the funiculus as long as the three following — *P. clarki* new sp.

7. Anterior border of the clypeus produced to a blunt point, the first segment of the funiculus as long as the two following
P. brunea new sp.

B. Gaster much darker brown than the head and thorax.
Clypeus carinated.

8. Scape extends beyond the occipital border by half its length
P. mjobergi Forel.
9. Scape extends beyond the occipital border by a third of its length, and the first segment of the funiculus is as long as the three following
P. nigriventris new. sp.
10. Scape extends beyond the occipital border by a third of its length, and the first segment of the funiculus is as long as the two following
P. quadrata new. sp.

Clypeus not carinated.

11. Head longer than broad with the sides strongly convex and the anterior border of the clypeus produced to a blunt point
P. abruptus Clark.
12. Head nearly square with the sides feebly convex and the anterior border of the clypeus rounded
P. robustus new sp.
13. Scape extends beyond the occipital border by a quarter of its length, and the anterior border of clypeus produced to a blunt point
P. pallidus Clark
14. Scape extends beyond the occipital border by a third of its length, anterior border of clypeus rounded, and the declivity of the epinotum evenly straight or feebly convex
P. hemiflavus Clark.
15. Scape . . . : but the declivity is not straight but at middle of its length has a very obtuse angle which forms two almost straight planes
var. *wilsoni* new var.

C. Uniformly very dark brown.
Clypeus produced to a blunt point in front.

16. Anterior border of clypeus produced to a blunt point; epinotal declivity a third longer than the dorsum; first segment of the funiculus as long as the three following
P. flavicornis Clark
17. . . . . first segment of funiculus as long as the two following
var. *minor* new var.
18. Anterior border of clypeus produced to a blunt point; epinotal declivity twice as long as the dorsum; first segment of the funiculus as long as the two following
P. flavidiscus new sp.
19. Anterior border of the clypeus produced to a blunt point; epinotal declivity twice as long as the dorsum; first segment of the funiculus slightly longer than the second segment
P. wheeleri new sp.

Anterior border of the clypeus rounded.

20. Epinotal declivity twice as long as the dorsum
P. reticulata new sp.

21. Epinotal declivity only slightly longer than dorsum, but the dorsum does not overhang the declivity—
    (a) node only half as high as declivity
    P. depressiceps Emery.
22. (b) node nearly as high as declivity
    var. *similis* new var.
23. Epinotal declivity only slightly longer than the dorsum, but the dorsum overhangs the declivity to a marked degree—
    (a) clypeus carinated and frontal area indistinct
    P. nitidissimus Andre.
24. (b) clypeus subcarinated and frontal area distinct
    P. nitidissimus var. *formicoides* Forel.
25. Epinotal declivity slightly longer than the dorsum. Anterior border of the clypeus bluntly pointed. First segment of the funiculus slightly longer than the second
    P. niger Clark.

CHARACTERISTICS COMPARED

Species	Length mm.	Clypeus	Scape extends over the occiput by—	First segment of funiculus longer than—	Epinotal declivity	Colour
advena	3 mm.	rounded; carinate	quarter of length	two following	twice Dorsum	Uniformly light brown
hellenae	2.5 mm.	rounded; carinate	third of length	two following	three times Dorsum	
antennata	3–3.4 mm	pointed; carinate	half of length	two following	just longer than D.	
zealandica	3 mm.	rounded; not carin.	third of length	two following	twice Dorsum	
convexa	3.4–3.6	rounded; not carin.	half of length	two following	just longer than D.	
clarki	2.5–3 mm.	pointed; not carin.	third of length	three following	twice Dorsum	
brunea	3.4 mm.	pointed; not carin.	third of length	two following	twice Dorsum	
mjobergi	3.5–4 mm.	rounded; carinate	half of length		longer than Dorsum	Gaster darker brown than head and thorax
nigriventris	3–4 mm.	rounded; carinate	third of length	three following	just longer than D.	
quadrata	3.5–4 mm.	rounded; carinate	third of length	two following	twice Dorsum	
abruptus	3.5 mm.	pointed; not carin.	half of length	as long as two following	two and half times D.	
robustus	3.4–4 mm.	rounded; not carin.	half of length	two following	twice Dorsum	
pallidus	2.2–2.8	pointed; not carin.	quarter of length	two following	twice Dorsum	
hemiflavus	2.7–3.2	rounded; not carin.	third of length	three following	twice Dorsum	
wilsoni	3 mm.	rounded; not carin.	third of length	two following	twice Dorsum	
flavicornis	3–4 mm.	pointed; sub-carin.	half of length	three following	just longer than D.	Uniformly very dark brown
minor	3.5 mm.	pointed; sub-carin.	half of length	two following	just longer than D.	
flavidiscus	3.4–3.6	pointed; sub-carin.	third of length	two following	twice Dorsum	
wheeleri	3.4–3.8	pointed; carinate	half of length	one following	twice Dorsum	
reticulata	3.4–4 mm.	rounded; carinate	half of length	one following	twice Dorsum	
depressiceps	3–3.5 mm.	rounded; carinate	half of length	one following	just longer than D. twice height of node	
similis	3–3.5 mm.	rounded; carinate	half of length	one following	just longer than D. as high as node	
nitidissimus	3.5–4 mm.	rounded; carinate F. area indistinct	half of length	one following	just longer than D. Dorsum overhanging	
formicoides	3.3–4.2	sub-carinate F. area distinct	half of length		just longer than D. Dorsum overhanging	
niger	3.4–3.8	pointed; sub-carin.	half of length	one following	just longer than D.	Black

1. *Prolasius advena*, Smith. (Plate I. figs. 1, 2, 3)

Formica advena Smith, Trans. Ent. Soc. Lond. I (3) p. 53. 1862 ☿ ♀
Kirby, Journ. N. Zeal. Instit., 2. p. 70, 1884. ☿ ♀
Prenolepis advena, Mayr, Verh. Zool. Bot. Ges. Wien. 36, p. 362, 1886.
Lasius (*Prolasius*) *advena*, Forel, Mitt. Schwiez. Ent. Ges. 8, p. 332, 1892. ☿ ♂ ♀
Melophorus (*Lasiophanes*) *advena*, Emery, Act. Soc. Sc, Chili, 5, p. 16, 1895.
Melophorus (*Prolasius*) *advena*, Emery, Genera Insect. fasc. 183, p. 14, 1925.
Prolasius advena, Wheeler, Proc. Amer. Acad. Arts & Sc., 62, p. 127, 1927.

Redescribed from specimens from Christchurch, N.Z.

Worker:

Length 3mm. Brown with thorax and legs a slightly lighter brown.

Shining; microscopically punctate throughout; legs densely punctate but the promesonotum is very sparsely punctate.

Hair yellow, long, erect but confined to the mandibles, clypeus and gaster.

Pubescence greyish, very fine, adpressed, abundant throughout but not hiding the sculpture.

Head one fourth longer than broad, almost rectangular, with sides and the occipital border feebly convex, and the corners broadly rounded. Mandibles triangular, furnished with six strong sharp teeth, the first three being very much longer than the others. Clypeus rounded in front and carinated. Frontal area transversely triangular. Frontal carinæ parallel, short, as long as their distance apart. Scapes extend beyond the occipital border by barely a fourth of their length. The first segment of the funiculus is slightly longer than the two following taken together, the fourth to the tenth longer than broad, while the apical segment is longer than the two preceding taken together. The eyes are large and placed at the middle of the sides of the head. The ocelli are small.

The thorax is twice as long as broad. The pronotum is a quarter broader than long with the sides very strongly convex, and is fully twice as broad as the rest of the thorax. Mesonotum is as long as broad and has the sides feebly convex. The epinotum which is slightly wider behind than in front, is a shade longer than broad. In profile the pronotum and mesonotum form an almost even convexity, while the epinotum is much lower than the mesonotum. The dorsum of the epinotum forms an almost straight line elevated towards the back. The epinotal declivity is straight and twice as long as the dorsum. The node is thorn-like, transversely convex, while in profile the anterior face is faintly convex, the posterior face almost flat with a slight thickening towards the base. Gaster slightly longer than broad. Legs long and slender.

Female: Described by Forel, Mitt. Schweiz. Ent. Gest. 8, p. 322, 1892.

Length: 5-6mm.

Head broader than long. Thorax high, broader than the head. Scale emarginate above. Head and gaster more plentifully provided with adpressed pubescence than the worker. Mandibles with seven teeth. Anterior edge of the clypeus as in the worker, triangular, produced medially. In other respects like the worker.

Male: Described by Forel.

Length: 2·8 mm.

Mandibles with broad concave terminal edge which bears a pointed terminal tooth with a small blunt tooth in front. Outer genitalia, particularly the plate rather large. Scale rounded above, not emarginate. Wings almost water clear.

Original habitat: Port Lyttleton, N.Z.

2. *Prolasius hellenae*, new species. (Plate I, figs. 8-9).

Worker:

Length 2·5mm.

Colour of uniform dull yellow or yellowish brown, with antennæ and legs lighter.

Microscopically punctate throughout.

Hair yellow, long, erect on clypeus and gaster, suberect on mandibles. Pubescence yellow, very fine, adpressed and abundant throughout.

Head one third longer than broad, slightly narrower behind than in front, with sides strongly convex, and occipital border fairly convex. Mandibles triangular, furnished with five uneven sharp teeth. Clypeus rounded in front, carinated. Frontal area triangular. Frontal carinæ short, as long as their distance apart, parallel. Scapes extend beyond the occipital border by more than a third of their length. First segment of the funiculus longer than the two following taken together, third as long as broad, fourth longer than broad, fifth to tenth nearly twice as long as broad, apical as long as the preceding two taken together. Eyes large and rather flat. Ocelli small. Thorax twice as long as broad. Pronotum broader than long, sides strongly convex. Mesonotum one and a quarter times longer than broad, with the sides straight. Epinotum slightly broader than long, faintly broader behind than in front, with the sides almost straight. In profile the pronotum and mesonotum form an even convexity. Epinotum has the dorsum straight or feebly convex, and raised behind. Epinotal declivity straight, fully three times as long as the dorsum.

Node transversely convex. In profile thorn-like, very narrow and sharp, with the anterior face convex, and the posterior face straight or feebly concave. Legs rather robust.

Collected by Miss E. Clark. Katoomba, N.S.W.

Type in the National Museum of Vic.

3. *Prolasius antennata*, new species. (Plate I, figs. 4-5.)

Worker:

Length: 3-3·4mm.

Reddish brown with antennæ, legs and mandibles much lighter. Smooth and shining.

Hair whitish, erect, rather short, apparent on clypeus, mandibles, scapes pronotum and gaster. Pubescence also whitish, fine, adpressed and abundant throughout.

Head almost a quarter longer than broad, with sides feebly convex, the occipital border definitely convex, and the corners broadly rounded. Mandibles triangular furnished with six teeth. Frontal area transversely triangular. Frontal carinæ short, parallel and as long as their distance apart. Scapes extend beyond the occipital border by almost half their length. First segment of funiculus almost as long as the following two taken together, the rest longer than broad, the apical segment almost as long as the two preceding together. Eyes large and convex, placed just behind the middle of the sides. Ocelli very small.

Thorax twice as long as broad. Pronotum twice as broad as long, with sides strongly convex. Mesonotum almost as broad as long, with the sides feebly convex, broader in front than behind. Epinotum slightly broader than long with sides very feebly convex or almost straight. In profile the pronotum and mesonotum form an almost even convexity. The dorsum of the epinotum is convex, and the almost straight declivity is just slightly longer than the

dorsum. Node convex transversely. In profile thorn-like, bluntly pointed almost as high as the epinotum, and has the anterior face and posterior face almost straight. Legs slender.

Collected by J. Clark. Ludlow, W.A.

Type in the National Museum of Vic.

4. *Prolasius zealandica*, Smith.

Formica zealandica, Smith, Trans. Ent. Soc. Lond., p. 6, 1878. ♀
Emery, Genera Insect. fasc. 183, p. 271, 1925.
Colobopsis zealandica, Wheeler, Bull. Amer. Acad. Arts & Sc., 62, p. 127, 1927.

Original description by Smith.

Female:

Length: 2½ lines.

The abdomen black, the head and thorax blackish brown, covered with a fine cinereous pile, which is most dense on the abdomen; mandibles, the scapes of the antennæ, and the flagellum at their base and apex pale rufo-testaceous. The thorax ovate, smooth and shining, the metanotum obliquely truncate, the femora rufo-fuscus, with their apex, the tibia and tarsi pale rufo-testaceous; the tibiæ usually more or less fuscus in the middle. Abdomen ovate shining with the margin of the segments very narrowly testaceous; scale of petiole ovate and emarginate above.

Collected by Prof. Hutton. New Zealand.

New description of worker from Nelson, New Zealand.

Worker:

Length: 3mm.

Testaceous with gaster and head darker brown.

Head mesonotum and epinotum covered with shallow microscopic punctures. Hair yellow, long, erect confined to the gaster and the clypeus. Pubescence whitish, fine, adpressed, abundant throughout but not hiding the sculpture. Head slightly less than a quarter longer than broad with the sides and occipital border convex, but to a very small degree, corners broadly rounded. Mandibles triangular and furnished with six short sharp teeth. Clypeus rounded in front, and not carinated. Frontal area transversely triangular. Frontal carinæ parallel and slightly longer than broad. The scapes extend beyond the occipital border by more than a third of their length. The first segment of the funiculus is slightly longer than the two following together, the fourth as long as broad while the apical is slightly longer than the two preceding taken together. Eyes moderately large and convex, placed just behind the middle of the sides. Ocelli small.

Thorax little more than twice as long as broad. Pronotum slightly broader than long, with very strongly convex sides. The promesonotal suture deeply impressed. Mesonotum one and a half times longer than broad, with straight parallel sides. Epinotum slightly broader than long, feebly convex, and very slightly broader behind than in front. In profile the pronotum and mesonotum form an almost even convexity. Epinotum slopes upward behind, and the dorsum is almost straight or feebly convex.

Epinotal declivity straight and almost twice as long as the dorsum. Node convex transversely, while in profile the anterior face is feebly concave and the posterior face straight. Legs slender.

Collected by E. B. Gourley. Nelson, New Zealand.

5. *Prolasius convexa,* new species. (Plate I, figs. 6-7).

Worker:

Length: 3·4-3·6mm.

Bright ferruginous throughout, but antennæ, legs and mandibles lighter. Smooth and shining.

Hair yellow, long, erect, confined to the clypeus and gaster. Pubescence yellow, fine, adpressed almost confined to legs and funiculus.

Head as broad as long—almost circular—with the sides and the occipital border very strongly convex, and the corners broadly rounded. Mandibles triangular, furnished with six strong teeth. Clypeus rounded in front, not carinated. Frontal area triangular transversely. Frontal carinæ short, diverging slightly. Scapes extend beyond the occipital border by almost half their length. First segment of the funiculus longer than the two following together, third very short, fourth to tenth longer than broad, apical segment almost as long as the two preceding together. Eyes large convex, placed at the middle of the sides. Ocelli small.

Thorax twice as long as broad. Pronotum as long as broad with sides strongly convex. Mesonotum one third longer than broad, anterior two thirds of sides slightly convex, and wider apart than posterior third, whose sides are straight. Epinotum twice as broad as long, sides feebly convex, broader behind than in front. In profile the pronotum and mesonotum form an even convexity, with a deep indentation at the promesonotal suture. Epinotal dorsum straight or very feebly convex, inclined upwards behind. Declivity straight, at right angles to the dorsum, and a quarter longer than the dorsum. Node transversely convex. In profile thorn-like, almost twice as high as broad, with anterior face convex. and posterior face almost straight. Legs slender.

Collected by P. J. Darlington. Dorrigo, N.S.W.

Type in the National Museum of Vic.

6. *Prolasius clarki,* new species. (Plate I, figs. 26-27).

Worker:

Length 2·5-3mm.

Ferruginous with antennæ and legs lighter; in some specimens the colour is mottled dark ferruginous with the pronotum and mesonotum lighter. Smooth and shining.

Hair yellow, short, erect, apparent only on the clypeus and gaster. Pubescence yellow, very fine, adpressed, abundant throughout but not hiding the sculpture.

Head very slightly longer than broad, with the sides convex, and the occipital border concave. Mandibles triangular, furnished with six fairly even teeth. Clypeus produced to a blunt point in front, not carinate. Frontal area transversely triangular. Frontal carinæ short and parallel. Scapes extend beyond the occipital border by almost a quarter of their length. First segment of the funiculus almost as long as the three following taken together, rest longer than broad, the apical segment as long as the two preceding together. Eyes small, placed slightly behind the middle of the sides. Ocelli small.

Thorax twice as long as broad. Pronotum slightly longer than broad, with sides strongly convex. Mesonotum one and a half times as long as broad, with the sides almost straight. Epinotum slightly broader than long, with the sides straight. In profile pronotum and mesonotum form an even convexity. The epinotum is straight and elevated behind, while the declivity is straight or

feebly concave, and twice as long as the dorsum. Node convex transversely. In profile thorn-like, bluntly pointed, with anterior face straight and posterior face faintly convex. Legs slender.

Female:

Length: 5·5mm.

Colour more uniformly light ferruginous. Pilosity as in worker. Microscopically punctate throughout. Occipital border and sides of head almost straight, the angles broadly rounded. Eyes and ocelli large and convex. Antennæ and mandibles as in worker. Thorax one and a half times as long as broad. Pronotum very short. Mesonotum slightly broader than long, with sides and front strongly convex. Parapsidal furrows fully half as long as the dorsum, and clearly impressed. Scutellum one quarter broader than long. Epinotum four times as broad as long.

Collected by P. J. Darlington. Barrington Tops, N.S.W.

Type in the National Museum of Vic.

7. *Prolasius brunea*, new species. (Plate I, figs. 22-23).

Worker:

Length: 3·4mm.

Dark ferruginous with antennæ and legs lighter. Some examples are dark reddish ferruginous with antennæ and legs yellowish.

Microscopically punctate throughout.

Hair yellow, long, confined to clypeus, mandibles and gaster. Pubescence yellow, fine, adpressed,, abundant throughout but not hiding the sculpture. Head about a quarter longer than broad, with sides feebly convex and occipital border almost straight, corners broadly rounded. Mandibles triangular, furnished with six fairly even teeth. Clypeus broadly pointed in front, not carinated. Frontal area transversely triangular. Frontal carinæ as long as the distance separating them, parallel. Scapes extend beyond the occipital border by almost a third of their length. First segment of funiculus almost as long as the two following together, fourth as broad as long, rest almost twice as long as broad, apical as long as the two preceding together. Eyes large, convex, placed at the middle of the sides. Ocelli small.

Thorax two and a half times as long as broad. Pronotum as long as broad, sides strongly convex. Mesonotum slightly longer than broad, with the sides almost straight. Epinotum one and a half times as long as broad, with the posterior margin wider than the anterior margin, and sides almost straight. In profile pronotum and mesonotum form an even convexity. Epinotum almost straight, raised slightly behind. Declivity straight, fully twice as long as the dorsum. Node much lower than the epinotum, transversely convex. In profile sharp pointed, with anterior face convex, posterior face almost straight. Legs slender.

Collected by J. Clark. Millgrove, Vic.

Type in the National Museum of Vic.

8. *Prolasius mjobergi*, Forel.

Prenolepis mjorbergi, Forel. Arkiv. f. Zool, 9, 16, p. 93, pl. 2, fig. 6, 1915. ☿
Prenolepis mjobergiellus, Santschi, Bull. Soc. Ent. Fr. p. 242, 1916.
Melophorus mjobergiellus, Emery, Genera Insect. fasc. 183, p. 12, 1925.

Translated from Forel's description in Arkiv. f. Zool.

Worker:

Length: 3·5-4mm.

Bright brown, gaster dark brown. Mandibles, funiculus and tarsi brownish yellow.

Hair reddish, sparse, fine on head and gaster. Pubescence reddish confined to the limbs.

Shining. Thorax and node almost wholly smooth. Head and limbs delicately and finely reticulate rugose or punctate. Gaster also transversely rugose, and with scattered reddish brown bristles.

Head rectangular, about a quarter longer than broad, in front and behind equally broad, with very feebly convex sides, almost straight occipital border and rounded angles. Mandibles shining, distinctly and finely longitudinally striate with scattered fine punctures, and furnished with six teeth, of which the last two are longer. Clypeus carinated on anterior two thirds, rounded on frontal border, but pointed in the middle. Frontal area triangular, rather convex and smooth. Frontal carinæ feebly diverging. Eyes large and feebly convex, placed at the middle of the sides. Ocelli very small but moderately distinct. The scapes extend beyond the occipital border by half their length. The segments of the funiculus almost three times as long as broad.

The pronotum as broad as long, convex on all sides. Mesonotum almost twice as long as broad, more convex transversely than longitudinally. Epinotum broader than the mesonotum. Dorsum of the epinotum about a third longer than broad, feebly convex, hardly higher behind than in front, with the mesonotum it forms a strong broad hump. The declivity of the epinotum upright, even, longer than the dorsum, into which it turns with a sudden strong curve. Node thick, above wholly bluntly rounded, almost twice as high as thick (long) strongly inclined, anterior face convex, posterior face almost straight. Gaster short. Legs very long.

Malanda, Q.

9. *Prolasius nigriventris*, new species. (Plate I, figs. 12-13).

Worker:

Length: 3-4mm.

Thorax ferruginous with legs much darker. Head in many specimens a reddish brown with the antennæ lighter—lighter than the colour of the thorax. Node and gaster very dark blackish brown.

Smooth and shining.

Hair yellow, long, erect confined to gaster, clypeus and mandibles.

Pubescence greyish, adpressed, abundant on antennæ and legs, less noticeable on head and rest of body.

Head very slightly longer than broad, sides convex, occipital border straight, angles rounded. Mandibles triangular, furnished with six strong, fairly even teeth. Clypeus rounded in front, carinated. Frontal area rather rounded behind. Frontal carinæ moderately long, diverging outwards behind. Scapes extend beyond the occipital border by more than a third of their length. First segment of the funiculus nearly as long as the three following, rest longer than broad, apical segment as long as the two preceding together. Eyes large, placed about the middle of the sides. Ocelli small but distinct.

Thorax twice as long as broad. Pronotum broader than long, with the sides strongly convex. Mesonotum slightly longer than broad, with sides almost straight, wider in front than behind. Epinotum slightly broader than long, drawn in at the mesoepinotal suture, but with the sides almost straight, and parallel. In profile pronotum and mesonotum are both convex, but the convexity

is broken by the deep suture. The epinotum is very feebly convex raised slightly behind. The epinotal declivity is straight and about a quarter longer than the dorsum. Node transversely convex, three times as wide as long. In profile rather rectangular with anterior face convex, the posterior face straight and the dorsum rather flattened. Legs rather robust.

Male:

Length: 3·7mm.

More uniformly dark brown, with the head slightly darker. Mandibles yellow. Smooth and shining.

Hair and pubescence more yellowish. Hair long on top of head and thorax.

Head slightly broader than long, sides strongly convex, occipital border straight, angles very sharp. Mandibles very small, edentate. Clypeus almost straight in front, with anterior border edentate. Frontal carinæ not clearly impressed. Scapes extend beyond the occipital border by almost half their length, their bases exposed. Funiculus twelve segmented. First segment broader than any of the others, and as long as the two following together, apical segment as long as the preceding two.

Thorax has short pronotum which from above is twice as broad as long. Mesonotum almost circular. Scutellum longer than broad, sides almost straight, broader in front than behind. Metanotum about three times as broad as long. Epinotum as long as broad, sides convex. In profile the pronotum is raised behind. Mesonotum high, strongly convex from apex to base. Scutellum convex, slightly higher than the mesonotum; epinotum feebly convex, declivity oblique, longer than the dorsum into which it is rounded. Node from above is twice as broad as long, convex transversely. In profile it is rather rectangular with the faces slightly convex, about one and three quarters as high as long.

Collected by D. J. Mahony. Deal Island, Vic.

Type in the National Museum of Vic.

10. *Prolasius hemiflavus,* Clark.

Clark, Mem. Nat. Mus. Vict. 8, p. 68, Pl. 4, figs. 28-29, 1934. ☿ ♀

Worker:

Length: 2·7-3·2mm.

Head, thorax, node, antennæ and legs ochraceous; gaster brownish, apex of gaster yellowish.

Smooth and shining; head, thorax, antennæ and legs very finely and densely punctate.

Clypeus strongly convex, not carinate, anterior border rounded. Scapes extend beyond the occipital border by almost a third of their length. First segment of funiculus larger than the three following together. Epinotal declivity twice as long as the dorsum.

Beech Forest, Vic.

11. *Prolasius hemiflavus* var. *wilsoni,* new variety. (Plate I, figs. 16-17).

Worker:

Length: 3mm.

Dull yellow with the gaster very much darker—a dull brown in some specimens.

Hair yellow, long, erect, confined to the gaster. Pubescence yellow, very fine adpressed, abundant throughout, but more noticeable on the darker gaster.

Shining; microscopically punctate throughout.

Head slightly longer than broad, sides convex, occipital border almost straight. Head as in *P. hemiflavus* except that the first segment of the funiculus is larger than only the two following segments together. Thorax slightly more than twice as long as broad. Pronotum very slightly longer than broad, sides strongly convex. Mesonotum slightly longer than broad, broader in front than behind. Epinotum as broad as long, very much narrower than the mesonotum. In profile similar to *P. hemiflavus.* The epinotal declivity slightly convex, with a very obtuse angle at the centre so that the upper half of this face slopes outward towards the node, the lower half is almost straight and vertical. The whole declivity is twice as long as the dorsum. Node seen from above is very narrow and transverse, almost straight. In profile it is sharp pointed with the faces straight, and only half as high as the epinotum. Legs slender.

Collected by F. E. Wilson. Bogong Plains, Vic.

Type in the National Museum of Vic.

12. *Prolasius pallidus,* Clark.

Clark, Mem. Nat. Mus. Vict. 8., p. 67, pl. 4, figs. 26-27, 1934. ☿ ♀

Worker:

Length: 2·2-2·8mm.

Pale ochraceous yellow; gaster slightly darker.

Clypeus produced to a blunt point in front, not carinated. Scapes extend beyond the occipital border by one quarter of their length. First segment of the funiculus slightly longer than the two following together, second and fourth as long as broad, third shortest, one third broader than long, fifth to ninth longer than broad, tenth as long as broad, apical longer than the two preceding together. Dorsum of epinotum half as long as the declivity.

Beech Forest, Vic.

13. *Prolasius abruptus,* Clark.

Clark, Mem. Nat. Mus. Vict., 8 p. 66, pl. 4, fig. 25, 1934. ☿

Worker:

Length: 3·5mm.

Ferruginous; mandibles, antennæ and legs lighter; gaster brownish.

Scapes extend beyond the occipital border by barely half their length. *First segment of the funiculus as long as the two following together,* second and third as long as broad, fourth to tenth longer than broad, apical as long as the two preceding together.

Gellibrand, Vic.

Note.—The original description gives "first segment of the funiculus twice as long as the two following together." After checking the type and several paratypes it was found that this is incorrect and it was necessary to make the above correction.

14. *Prolasius quadrata,* new species. (Plate I, figs. 10-11).

Worker:

Length: 3·5-4mm.

Head and thorax dull yellow; gaster dark brown, lighter than *P. robustus.*

Microscopically punctate throughout, but smoother than *P. robustus.*

Hair yellow, long, erect, sparse, confined to clypeus and gaster. Pubescence yellow, very fine, adpressed, abundant throughout but not hiding the sculpture.

Head noticeably rectangular, slightly longer than broad, sides and occipital border almost straight, corners broadly rounded. Mandibles triangular furnished with five sharp teeth. Clypeus broadly rounded in front, carinated. Frontal

area almost rounded behind. Frontal carinæ as long as their distance apart, diverging slightly behind. Scapes extend beyond the occipital border by one third of their length. First segment of the funiculus as long as the two following, second to fourth as long as broad, rest longer than broad, apical longer than the two preceding together. Eyes large and convex. Ocelli small.

Pronotum one and a half times broader than long, sides strongly convex. Mesonotum slightly longer than broad, broader in front than behind, sides straight. Epinotum broader than long, sides almost straight, slightly broader behind than in front. In profile pronotum and mesonotum form an even convexity with pronotum slightly higher than mesonotum. Dorsum of epinotum straight, and inclined upward behind. Epinotal declivity feebly convex, almost at right angles to the dorsum, and at least twice as long as dorsum. Node transverse, convex on top. In profile thorn-like, bluntly pointed above, with anterior face convex, posterior face almost straight. Legs slender.

Collected by W. M. Wheeler. Mt. Kosciusko, N.S.W.
Type in the National Museum of Vic.

15. *Prolasius robustus,* new species (Plate I, figs. 18-19).

Worker:

Length: 3·4-4mm.

Light brown with thorax, antennæ and legs of lighter colour.

Microscopically punctate throughout, rather dull, with gaster more shining.

Hair yellow, long, erect, confined to gaster, clypeus and mandibles. Pubescence yellowish, very fine, abundant throughout but not hiding the sculpture.

Head slightly longer than broad, squarish, sides and occipital border very feebly convex, angles broadly rounded. Mandibles triangular, furnished with five strong sharp teeth. Clypeus rounded in front, not carinated. Frontal area triangular. Frontal carinæ short and parallel. Scapes extend beyond the occipital border by half their length. First segment of the funiculus as long as the two following together, the rest twice as long as broad, the apical as long as the two preceding together. Eyes large and convex, ocelli small.

Thorax twice as long as broad. Pronotum broader than long with the sides strongly convex. Mesonotum twice as long as broad with the sides straight. Epinotum as long as broad, with the sides feebly convex. In profile the pronotum and mesonotum form an even convexity. Epinotum straight elevated behind. Epinotal declivity straight, more than twice as long as the dorsum. Node from above slightly convex. In profile it is thorn-like, bluntly pointed, with faces slightly convex, not half as high as the epinotum. Gaster large, twice as long as broad. Legs slender.

Collected by J. Clark. Fern Tree Gully, Vic.
Type in the National Museum of Vic.

16. *Prolasius flavicornis,* Clark.

Clark, Mem. Nat. Mus. Vic., 8, p. 69, pl. 4, figs. 31-32, 1934. ☿ ♀

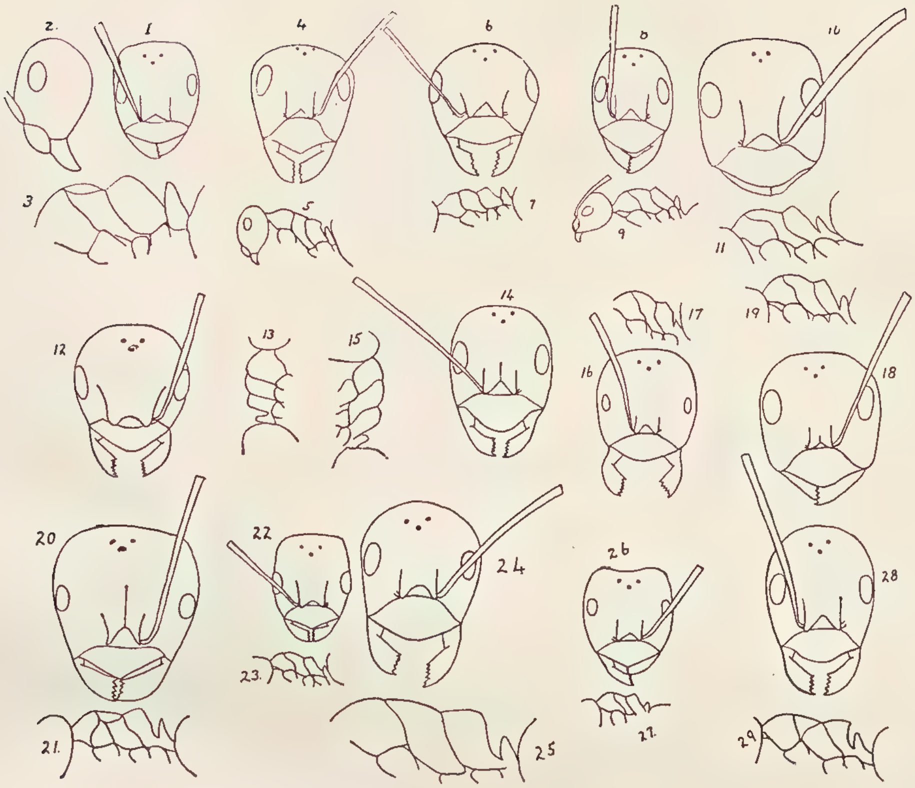
Worker:

Length: 3-4mm.

Blackish brown; antennæ and coxæ yellowish; legs and node brown.

Shining, microscopically punctate throughout. Mandibles very finely longitudinally striate.

Clypeus produced and bluntly pointed in front, subcarinated on anterior two thirds. Scapes extend beyond the occipital border by almost half their length. First segment of the funiculus as long as the three following together,



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second to fourth as broad as long, rest longer than broad. Epinotal declivity just longer than the dorsum.

Beech Forest, Vict.

17. *Prolasius flavicornis* var. minor, new variety.

Worker:

Length: 3·5mm.

Differs very little from the type. The colour is lighter. First segment of the funiculus is longer than the two following, but certainly not as long as the three following together.

Collected by W. M. Wheeler. Habitat: Sherbrooke Forest, Vic.
Type in the National Museum of Vic.

18. *Prolasius flavidiscus,* new species. (Plate I, figs. 20-21).

Worker:

Length: 3·4-3·6mm.

Dark almost blackish brown; legs, antennæ more reddish brown. The colour varies somewhat, some species being almost black, some have coxæ and articulations of the antennæ dark yellow, some have the body a reddish brown.

Shining but with small shallow punctures throughout, almost reticulate, more noticeable on the pronotum and back of head where there are rough little clusters of punctures.

Hair yellow, long, erect, and confined to the gaster and the clypeus. Pubescence yellowish, abundant on the antennæ and legs.

Head slightly longer than broad, sides slightly convex, occipital border almost straight, corners broadly rounded. Mandibles triangular furnished with five strong teeth. *Clypeus produced to a blunt point, faintly carinated.* Frontal area broadly triangular. Frontal carinæ slightly diverging behind. There is a faint frontal groove stretching beyond the eyes. *Scapes extend beyond the occipital border by more than a third of their length. First segment of the funiculus longer than the two following together,* rest longer than broad, the apical longer than the two preceding taken together. Eyes circular, convex, placed a little behind the centre of the sides. Ocelli very small.

Thorax a little more than twice as long as broad. Pronotum slightly broader than long, strongly convex, twice as broad as the rest of the thorax. Mesonotum one quarter longer than broad, with the sides almost straight. Epinotum as long as broad, broader behind than in front. In profile the pronotum and mesonotum form an even rather flat convexity. The epinotum slightly convex, raised behind, and higher than the mesonotum. The epinotal declivity straight and nearly twice as long as the dorsum.

The node is thorn-like, transversely convex. In profile it is sharply pointed, with the anterior face convex, and posterior face straight. Legs rather sturdy.

Female:

Length: 5·2mm.

The colour is of the worker, but with this noticeable difference—on the dorsum of the mesonotum, there is a large disc of bright yellow with a small spot of dark red in the centre.

The sculpture is coarser especially on the gaster. The pilosity similar to that of the worker but pubescence is found on the thorax and head. Head much the same as worker's but the clypeus is clearly carinated, the scapes slightly shorter. Eyes and ocelli large and convex.

Pronotum almost hidden, the mesonotum large and strongly convex in all directions, the parapsidal furrows not reaching the centre of the sides of the

mesonotum, but very clear and distinct. The upper edge of the node is very strongly concave so as almost to form two prongs.

Collected by J. J McAreavey. Mt. Ben Cairn, Vic.

Type in the National Museum of Vic.

19. *Prolasius wheeleri,* new species.

Worker:

Length: 3·4-3·8mm.

Very dark brown, gaster darker but legs and antennæ lighter.

Shining, reticulate punctate throughout.

Hair yellow, erect, scattered on clypeus, thorax and gaster. Pubescence greyish, very fine, adpressed, abundant throughout.

Head one quarter longer than broad, sides almost straight and parallel, occipital border convex, corners broadly rounded. Mandibles triangular, furnished with five teeth. Clypeus bluntly pointed in front, carinated, almost overhanging the mandibles. Frontal area convex behind. Frontal carinæ rather long, diverging behind. Eyes large, convex, placed about the middle of the sides. Ocelli large. Scapes extend beyond the occipital border by more than half their length. First segment of the funiculus slightly longer than the second, rest more than twice as long as broad, the apical segment almost as long as the two preceding together.

Thorax slightly more than twice as long as broadest part. Pronotum as broad as long, sides strongly convex. Mesonotum longer than broad by a half, sides almost straight. Epinotum as long as broad, sides feebly convex, broader behind than in front. In profile the pronotum and mesonotum form an even convexity with the pronotum slightly higher. The dorsum of the epinotum is convex, higher behind, and higher than the mesonotum. Epinotal declivity almost straight, or feebly concave, twice as long as the dorsum. Node thorn-like, flattened on top, posterior face, in profile, straight, while the anterior face is straight, with a slight inclination forward. Legs slender.

Collected by W. M. Wheeler. King's Park, Perth.

Type in the National Museum of Vic.

20. *Prolasius reticulata,* new species. (Plate I. figs. 14-15).

Worker:

Length: 3·4-4·4mm.

Dark reddish brown; legs, antennæ and mandibles lighter, more yellowish.

Microscopically reticulate throughout.

Hair yellow, long, erect, confined to gaster and clypeus. Pubescence greyish, very fine, adpressed, abundant throughout, but not hiding the sculpture.

Head one fifth longer than broad, sides convex, occipital border feebly convex, corners broadly rounded. Mandibles triangular, furnished with six strong sharp teeth, the apical being the longest. Clypeus carinated, rounded in front. Frontal area triangular. Frontal carinæ short, parallel. In some specimens there is a distinct frontal groove extending beyond the eyes, almost to the ocelli. Scapes extend beyond the occiput by fully half their length. First segment of funiculus one and a half times as long as second, rest two to three times as long as broad, apical almost as long as the two preceding together.

Thorax almost two and a half times as long as broad. Pronotum as long as broad, sides strongly convex. Mesonotum twice as long as broad, slightly broader behind than in front. Epinotum as long as broad, sides almost straight. In profile the pronotum and mesonotum form an even rather flat convexity with a deep depression at the suture. Epinotum convex, elevated behind and

rounded into the declivity. The epinotal declivity straight or feebly convex, twice as long as the dorsum. Node from above is straight, or feebly convex, transverse. In profile thorn-like, anterior face convex, posterior face straight, flattened on top. Legs slender.

Collected by J. Clark. Mundaring, W.A.
Type in the National Museum of Vic.

21. *Prolasius depressiceps*, Emery. (Plate I, figs. 24-25).

Melophorus, Emery, Boll. Lab. Zool. Portici, 8, p. 186, fig. 5a, 1914. Genera Insect. fasc. 183, p. 12, 1925.

Prolasius, Wheeler, Psyche, 42, p. 71, 1935.

Redescribed from ants from Katoomba, N.S.W.

Worker:

Length: 3-3·5mm.

Reddish dark brown, legs slightly lighter, mandibles orange.

Hair yellow, long, erect, confined to clypeus and gaster. Pubescence whitish very fine, adpressed, confined to legs and antennæ.

Smooth and shining; antennæ very finely punctate, gaster finely shagreened. Head slightly longer than broad, sides convex, occipital border convex, corners broadly rounded. Mandibles triangular, furnished with five strong, sharp teeth behind the apex. *Clypeus* rounded in front and *carinate.* Frontal area broadly triangular. Frontal carinæ barely as long as the distance between them and parallel. Eyes large, placed about the middle of the sides. Ocelli small but distinct. *Scapes extend beyond the occipital border by half their length. First segment of the funiculus slightly longer than the second,* rest nearly twice as long as broad, the apical segment as long as the two preceding taken together. Thorax twice as long as broad. Pronotum slightly longer than broad, sides strongly convex. Mesonotum one and a half times longer than broad, broader behind than in front, sides straight. Epinotum as broad as long, broader behind than in front, sides feebly convex. In profile pronotum and mesonotum form an even convexity, with a slight dip at the promesonotal suture. Dorsum of the epinotum strongly convex, and slightly elevated behind, joining the slightly concave and slightly longer declivity with a noticeable angle (right angle).

The node scale-like, convex transversely. In profile bluntly pointed with the anterior face strongly convex, the posterior face straight, about half as high as the epinotum. Legs slender.

Original Habitat: Katoomba, N.S.W.

22. *Prolasius depressiceps* var. *similis*, new variety.

This ant differs very slightly from the type. The node is very much higher than is the node of *P. depressiceps.* It is also very like *P. nitidissimus,* but the dorsum of the epinotum does not in any way overhang the declivity to form the very distinct angle described by Andre.

Collected by W. M. Wheeler, 1931. Mt. Kosciusko, N.S.W.
Type in the National Museum of Vic.

23. *Prolasius nitidissimus*, Andre. (Plate 1, figs. 28-29.)

Formica nitidissimus, Andre, Rev. d'Ent. Caen, p. 255, 1896. ☿

Melophorus nitidissimus, Emery, Boll. Lab. Zool. Sc. Agric., Portici viii. p. 186, fig. 5b, 1914. ☿

Melophorus nitidissimus, Emery, Genera Insect. fasc. 183, p. 12, 1925.

Prolasius nitidissimus, Wheeler, Psyche, 42, p. 71, 1935.
Redescribed from ants from Goulburn River, Vic.

Worker:

Length: 3·5-4mm.

Blackish brown, some with a reddish tint; legs, antennæ, mandibles slightly lighter.

Hair yellow, short, suberect apparently only on the clypeus and gaster. Pubescence whitish, very fine, adpressed, confined to legs and antennæ.

Smooth and shining, antennæ very finely punctate.

Head slightly longer than broad, sides fairly convex, occipital border convex corners broadly rounded. Mandibles triangular, furnished with five strong sharp teeth behind the apex. *Clypeus carinated.* Frontal area broad, almost convex behind. Frontal carinæ parallel, barely as long as the distance between them. Eyes large, placed about the middle of the sides. Ocelli small but distinct. *Scapes extend beyond the occipital border by half their length. First segment of funiculus slightly longer than the second,* the rest nearly twice as long as broad, the apical segment almost as long as the two preceding taken together. Pronotum slightly longer than broad, sides strongly convex. Mesonotum one third longer than broad, sides almost straight. Epinotum as long as broad, sides almost convex, slightly wider behind. In profile pronotum and mesonotum form an even convexity. Dorsum of epinotum convex. The declivity of the epinotum straight, slightly longer than the dorsum. *The dorsum joins the declivity at a very noticeable angle, and seems to overhang slightly the declivity.*

The node is scale-like, from above it is transverse, straight or faintly concave on top. In profile it is bluntly pointed above, the anterior face slightly convex, the posterior face straight. Legs slender.

Original habitat: Australian Alps, 1896.

24. *Prolasius nitidissimus* var. *formicoides,* Forel.

Melophorus formicoides, Forel, Rev. Suisse Zool. x, p. 483, 1902. ☿ ♀
Melophorus formicoides, Emery, Genera Insect. fasc. 183, p. 12, 1925. ☿ ♀

From Forel's description only.

Worker:

Length: 3·3-4·2mm.

Blackish brown; gaster brownish black. Legs, scapes, base of mandibles, and sometimes also the thorax and head brown. Rest of mandibles, funiculus reddish yellow. Posterior border of the segments of the gaster a clear brown.

Whole body chargined. Head evenly subopaque.

Coarse brown, stiff, thick, suberect hairs on gaster. Legs and scapes without hair but covered with very fine pubescence.

Head nearly square, slightly longer than broad, with the posterior border very distinct. The eyes are very much larger than in *P. nitidissimus,* being almost as long as their distance from the occipital angle. Ocelli distinct. *Scapes extend beyond the occipital border by more than half their length, the segments of the funiculus three times as long as broad. Clypeus subcarinate.*

The pronotum and mesonotum are more convex than in *P. nitidissimus* and the dorsum of the epinotum larger, while the declivity is as in *nitidissimus.* The node is much higher and thinner than in *P. nitidissimus.*

Female:

Length: 5·5mm.

Thorax larger than the head and strongly convex. The declivity of the epinotum flat and truncated. Node high, the upper border straight.

The whole body is covered with a very distinct greyish pubescence forming a light down. Legs reddish. The rest as in the worker.

Collected by G. Turner. Mackay, Q.

25. *Prolasius niger*, Clark.

Mem. Nat. Mus. Vict., 8, p. 68, 1934, ☿

Worker:

Length: 3·4-3·8mm.

Black. Mandibles antennæ and tarsi brown. Legs blackish brown.

Smooth and shining. Mandibles feebly striate and punctate. Clypeus microscopically reticulate. Scapes and legs very finely and densely punctate.

Clypeus sharply carinate on anterior two thirds.

Scapes extend beyond the occipital border by half their length. First segment of the funiculus slightly longer than second and twice as long as broad.

Beech Forest, Vic.

Genus MELOPHORUS, Lubbock, 1883.

Melophorus potteri, new species. (Fig. 1.)

Major Worker:

Length: 4·2-4·8mm.

Head and promesonotum bright red, epinotum and node brownish red, gaster shining black, mandibles brownish red.

Hair yellowish, long and confined to mandibles, clypeus and underside of gaster. Pubescence greyish, confined to funiculus, tibiæ and tarsi.

Mandibles shining, smooth with some scattered punctures. Head smooth and shining with very minute punctures. Pronotum transversely striate very finely. Mesonotum more feebly striate and the striation is rather circular. Epinotum reticulate and densely and finely punctate. The sides of the thorax very finely and densely reticulate though rather transversely striate on epinotum. Node very finely reticulate and the gaster very finely transversely striate.

Head excluding the mandibles very slightly longer than broad, slightly broader in front than behind, with almost straight sides and occipital border, the posterior angles broadly rounded. Mandibles large and broad, furnished with five even strong teeth. Clypeus strongly convex in front, raised and projecting over the mandibles to a very marked degree. Frontal carinæ very short, hardly noticeable in some specimens. Antennal insertions quite exposed. Frontal area faint, triangular, but no sign of frontal groove. Scapes extend to the occipital border. First segment of the funiculus twice as long as the second, remaining segments twice or almost twice as long as broad, apical segment slightly longer than the preceding one. Eyes small, rather flat, near the sides, with the anterior border just behind the middle of the sides. Ocelli small but distinct.

Thorax twice as long as its broadest part, which is a line through the pronotum. Pronotum slightly broader than long, with sides strongly convex. Mesonotum longer than broad, twice as broad in front as behind, with a marked depression near the mesoepinotal suture. The apex of this triangular depression, or metanotum is raised slightly over the dorsum of the epinotum. Epinotum twice as long as broad, the sides sloping inwards to form the dorsal surface which is one and three quarter times longer than broad, with feebly convex sides, convex posterior border, and broader behind than in front. In profile the pronotum and mesonotum form an even convexity with a marked promesonotal suture, metanotum small, its dorsum raised slightly behind. Epinotal dorsum

almost straight, passing by an even curve into the declivity, which is one and three quarter times longer than the dorsum, sloping outwards in a straight line towards the base of the node. Node nearly four times as broad as long, anterior face convex, posterior face concave, upper border deeply concave in middle. In profile scale-like, three times as high as long, with anterior face

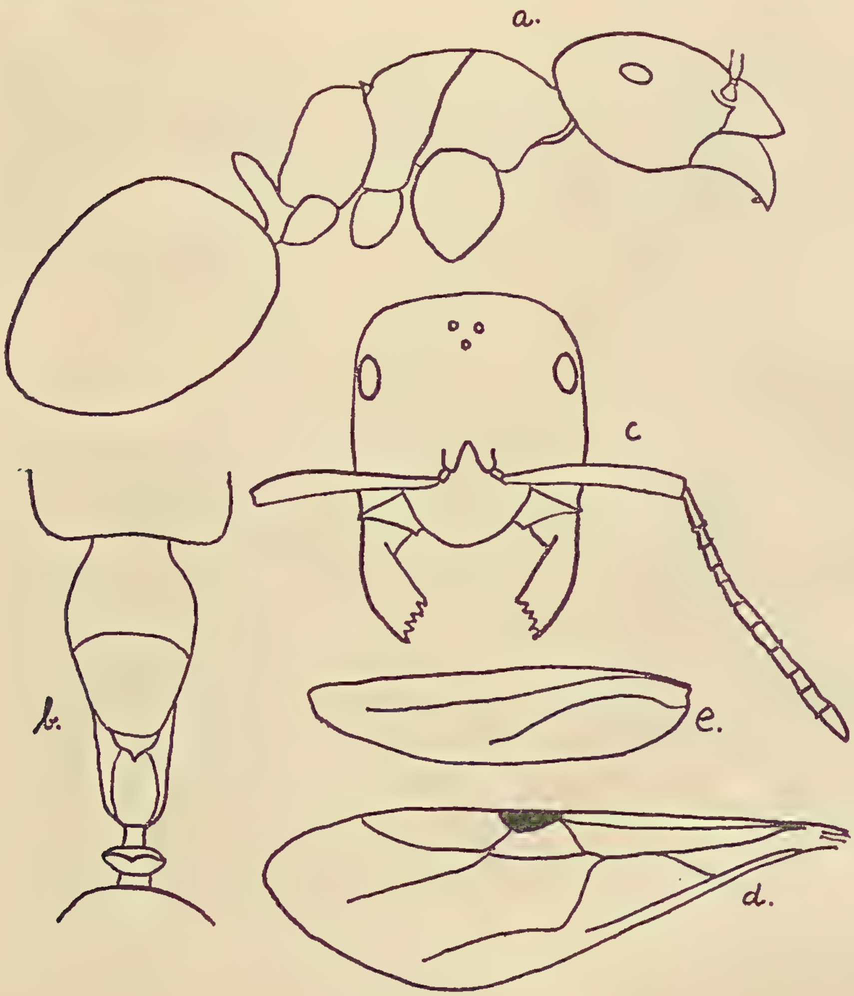

FIG. 1

FIG. 1. a. *Melophorus potteri* sp. nov., major worker. b. Dorsal, view of same. c. Head of major. d. and e. Wings of female.

feebly convex, posterior face almost straight, and bluntly pointed on top. Gaster oval. Legs robust.

Minor worker:

Length: 4mm.

The colour varies: some of the specimens are of the same colour as the major, except that the front of the head is more brownish, while others are very much darker. In these examples the head is dark reddish brown, the

thorax and node darker chestnut and the gaster brownish black. Legs light brown.

The sculpture is much finer, but there are no punctures.

The eyes are more oval than those of the major. The rest as in the major.

Female:

Length: 5·2mm.

Very like the major, and the colour sculpture and pilosity are the same. The pronotum is twice as wide as long with the sides feebly convex. Mesonotum large, almost circular, though very slightly wider in front than behind. Parapsidal furrows deep, longer than half the mesonotum. Scutellum broader than long, elliptical, with a wide suture separating it from the epinotum. It is smooth and shining. Epinotum transversely striate and twice as broad as long. The node is finer than that of the major, concave on top. In profile the mesonotum is higher than the pronotum with a feebly convex dorsum. The scutellum is lower than the mesonotum, while the epinotum is convex with a declivity concave, and much steeper than that of the major. The wings are almost colourless with the pterostigma light brown.

Collected by Mr. Herbert Potter of Patho, Victoria, who has previously contributed a number of new and very interesting raiding ants from his district.

Type in the National Museum of Vic.

PLATE I.

Fig.		
1.	*Prolasius advena* Smith	Worker, head from in front.
2.	*P. advena*	Worker, head in profile.
3.	*P. advena*	Worker, thorax in profile.
4.	*P. antennata,* new species	Worker, head.
5.	*P. antennata*	Worker, thorax in profile.
6.	*P. convexa,* new species	Worker, head.
7.	*P. convexa*	Worker, thorax.
8.	*P. hellenæ,* new species	Worker, head.
9.	*P. hellenæ*	Worker, thorax.
10.	*P. quadrata,* new species	Worker, head.
11.	*P. quadrata*	Worker, thorax.
12.	*P. nigriventris,* new species	Worker, head.
13.	*P. nigriventris*	Worker, thorax.
14.	*P. reticulata,* new species	Worker, head.
15.	*P. reticulata*	Worker, thorax.
16.	*P. hemiflarua* variety *wilsoni*	new var., worker, head.
17.	*P. hemiflavua* variety *wilsoni*	Worker, thorax.
18.	*P. robustus,* new species	Worker, head.
19.	*P. robustus*	Worker, thorax.
20.	*P. flavidiscus,* new species	Worker, head.
21.	*P. flavidiscus*	Worker, thorax.
22.	*P. brunea,* new species	Worker, head.
23.	*P. brunea*	Worker, thorax.
24.	*P. depressiceps* Emery	Worker, head.
25.	*P. depressiceps*	Worker, thorax.
26.	*P. clarki,* new species	Worker, head.
27.	*P. clarki*	Worker, thorax.
28.	*P. nitidissimus* Andre	Worker, head.
29.	*P. nitidissimus*	Worker, thorax.

NOTES ON AUSTRALIAN QUATERNARY CLIMATES AND MIGRATION

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Plate 2, Figs. 1-13.

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These notes were made, in the first instance, on climates suggested by the texture and fossils of some Victorian deposits that contained artefacts. But to understand the diversity of climates, it was found necessary to investigate the effects of the Postglacial and Pleistocene interglacial and glacial stages in the Southern Hemisphere and this led to their further elaboration. Apart from regulating the march of the climatic belts and its effect on habitability, it became evident that the interglacial and glacial stages were responsible for oscillations in sea-level that modified the geographical distribution of land and sea, particularly in northern Australia. Obviously, these oscillations had a profound bearing on immigration to Australia, but in a somewhat different way to that suggested elsewhere; the changing climate has also influenced migration in Australia.

Marett (1938) succinctly suggests the scope of this enquiry:

> The anthropo-geographer can afford to concentrate on climate, treating fauna and flora, and even avenues of migration, as dependent subjects. Calculating temperature, rainfall and so on for given regions as the climate varies, he can proceed to map out areas of relative habitability, suiting man more or less closely, according to his degree of culture . . . Thus the study of environment teaches the anthropologist where to look alike for the strong and for the weak among the human candidates for survival. Geographical considerations will not suffice to explain the full conditions of the struggle between ethnic types but whoever aspires to understand human history as a whole must at least acquire the map-making, map-reading faculty at the start.

In Australia, the pioneer of this class of research was Griffith Taylor (1919) who showed how changes in temperature affected the rain-belts now and under somewhat hotter (Pliocene) and colder (Quaternary) conditions. The basic principles underlying such an investigation he (Taylor, 1927) stated in the following words:

> If the land be subjected to cooler temperatures, this is equivalent to increasing the factors which bring the southern rain belt to Australia. We should expect a strengthening of this rain belt so that it should become broader; in effect, the desert would retreat to the north. If the climate as a whole became hotter we should expect a movement south of the desert and a deterioration in the living conditions of southern Australia.

He illustrates this by maps (Taylor, 1919, 1927).

In the several maps given here, the line of advance and retreat of the climatic belts is taken to be the axis of the overlap of the tropical low pressure rainfall and the southern low pressure rainfall; this is referred to here as the "line of maximum aridity." (Fig. 1).

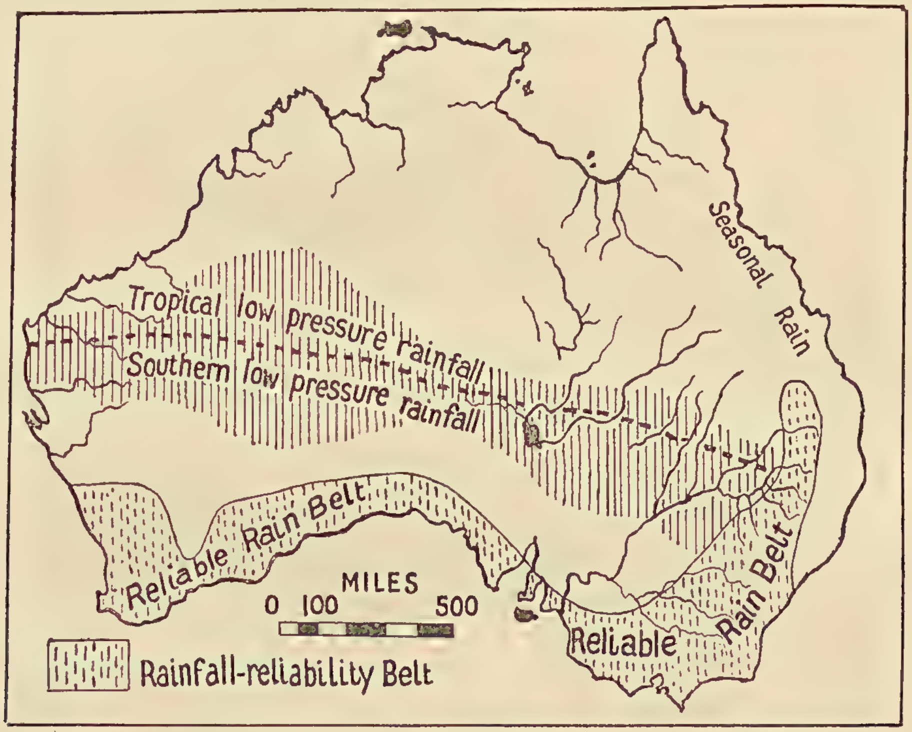

Fig. 1.
Present Line of Maximum Aridity and the Range of the Rainfall-reliability Belt.

This paper discusses:

I. The march of the climatic belts.
II. Rainfall: fertility and aridity.
III. Deposits containing artefacts.
   a. Tartanga and Devon Downs.
   b. Dunes at Altona and Point Cook.
   c. Deposits under lava-flows and volcanic ejectamenta.
IV. Bones shaped by man or animals.
V. Palaeogeography of the Postglacial and last glacial periods.
VI. Probable landing places.

VII. Critical millennia.
VIII. Migration routes in Australia.
IX. Digest of conclusions.

As far as possible, the writer has restricted his comments to the geology of deposits in south-east Australia containing artefacts, the climates implied by such deposits, and the palaeogeography at critical periods. Where references are made to social anthropology, their sources are given.

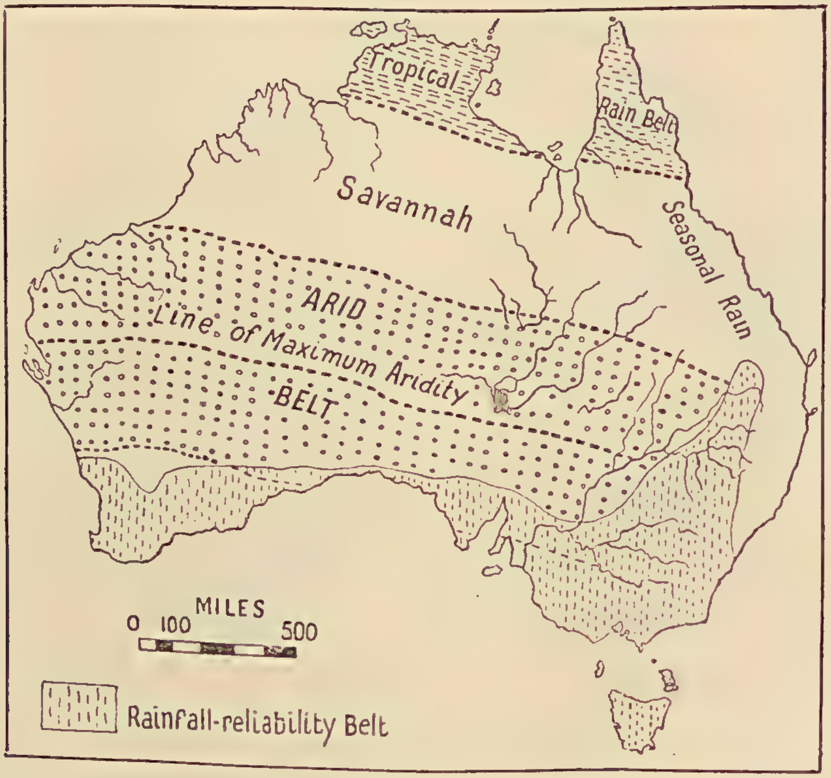

FIG. 2.
Climatic Belts and Rainfall-reliability Belt at the Postglacial Optimum.

(1). March of the Climatic Belts.

In Australia during the Quaternary period, the climatic belts moved northwards in the glacial periods and southwards in the Postglacial and interglacial periods; with them moved the forest, savannah, arid and steppe belts. A variation in temperature of 12° F. is involved, equivalent to a movement north or south of 800 miles. With the advance of the belts, a region may have passed successively from desert into savannah to tropical rain-forest; from aridity into relative fertility to revert on their

retreat to its former state. Thus the line of maximum aridity during the glacial period was approximately 200 miles south of Darwin, but at the Postglacial Optimum 400 miles north of Adelaide. (Fig. 2).

During the glacial period, only the higher altitudes of Australia were beset with glacial conditions—the Margaret glaciation—which were too restricted to affect to any extent the climate: any reference here to glacial or interglacial in connection with the mainland refers only to the periods when those stages prevailed in other latitudes. The following were the climatic, and hence the physical extremes, in the Australian region during the Quaternary:

	Postglacial and interglacial Periods.	Glacial Period.
New Guinea.	Tropical rain-forest.	Savannah.
Northern Australia.	Savannah and tropical rain-forest.	Arid belt.
Lake Eyre Basin.	Arid belt.	Steppe.
South-east Australia.	Steppe.	Temperate rain-forest.
Tasmania.	Temperate.	Glaciated.

The south-east, the coastal corridor, the orographic rainfall-belt and the extreme south-west of Australia have always been regions that have been more or less fertile; the rest of it has been at some time successively desert or on the borderline of complete aridity, savannah, steppe, or partly in the fertile belt. In Europe, the continental character of the climate during the retreat of the ice-sheet that ushered in the dry period, although largely influenced by geographical distribution, was, to some extent, due to astronomical causes, and assuredly had its equivalent in the Southern Hemisphere. It concluded about 4,000 B.C., when there was a period of submergence—the Atlantic stage. The Postglacial Optimum is placed here about 2,000 B.C.—i.e., 4,000 years ago (cf. Brooks, 1922). A progressive change of climate leading to the Postglacial Optimum has been assumed, although, doubtless, there have been minor climatic fluctuations; the small amount of geographical change that has occurred in Australia in the Postglacial—it has occurred mainly in the north—has probably made these less marked and infrequent. Glaciation ended in lowland Europe about 7,000 years ago, but the climate became appreciably warmer about 8,000 years ago.

Glaciation on the Australian mainland was restricted during the last glacial period to a small area on Mt. Kosciusko. In Tas-

mania there were at least three glaciations, in local terminology, the Margaret, Yolandean, and Malannan stages, most fully described by Lewis (1945). These are respectively probably the equivalents of the Wurm, Riss, and Mindel glacial stages of the Northern Hemisphere. The Margaret glaciation occurred after the formation of Bass Strait, the Yolandean and Malannan before. Two glaciations have occurred at Mt. Kosciusko (7328 ft.) on the Kosciusko plateau, the newer of which David (1923) has correlated with the Wurm (Margaret), and the older with the Mindel (Malannan). In regard to the more recent changes in climate, we are concerned with those after the Margaret glaciation; this David divided into the Post-Wurm Mountain Glaciation and the Wurm Glaciation, but seemingly, these may be regarded as phases of the Margaret. In respect to the summit of Mt. Kosciusko, he states that the Mountain Glaciation extended down to 6,400 feet and the Wurm down to 6,150 feet, 928 and 1,178 feet respectively below the summit.

The paths of the lows have changed with the passing north and south of the glacial, Postglacial, and interglacial periods: the eastern and western littorals have been most affected by the contemporaneous passing backwards and forwards of the rain-belt. Information concerning the present paths of the depressions is far from complete and any deductions from it must necessarily be tentative.

The general direction of the high pressure belt with its complementary lows is, in the Australian region, a little south of east. Due to the existence of a greater land-surface in the Northern Hemisphere, their direction is there less defined. Brooks (1926) states:

> Although the paths of the individual depressions in temperate regions often appear to be erratic, it has been found possible to classify them into a number of tracks, which are more usually followed than the intervening regions. These tracks have a preference for moist areas, especially such inland seas as the English Channel, the Baltic, and the Mediterranean, or for well watered plains such as Hungary and Poland . . . The question of the tracks of depressions is important for palaeometeorology, for a considerable degree of permanence has been attributed to them.

As most of the reliable rainfall along the south coast of Australia is associated with the winter Antarctic low, the average position of its axis is important from the standpoint of this discussion. Taylor (1920) shows that it trends E.S.E. by a straight line from a point about 250 miles south of Cape Leeuwin and that it enters Bass Strait between King Island and Tasmania. This is the path at present, 4,000 years after the Postglacial Optimum; it was also the path 4,000 years before the Postglacial

Optimum, or 8,000 years ago. The probable paths now and in the past are shown in Fig. 3.

The Southern Ocean Current profoundly affects the climate of a large part of Australia, particularly its south-eastern portion. It bifurcates some hundreds of miles south-west of Cape Leeuwin: one branch flows northwards up the west coast, the other eastwards along the south coast impelled by the anti-trade winds. It receives a great indraft of cold water from the Antarctic Ocean, and, west of Cape Leeuwin, a surface indraft of warm water from the Indian Ocean. The *Challenger* Expedition recorded the latter as a warm sub-surface current off Cape Northumberland at the south-east corner of South Australia about 400 miles wide

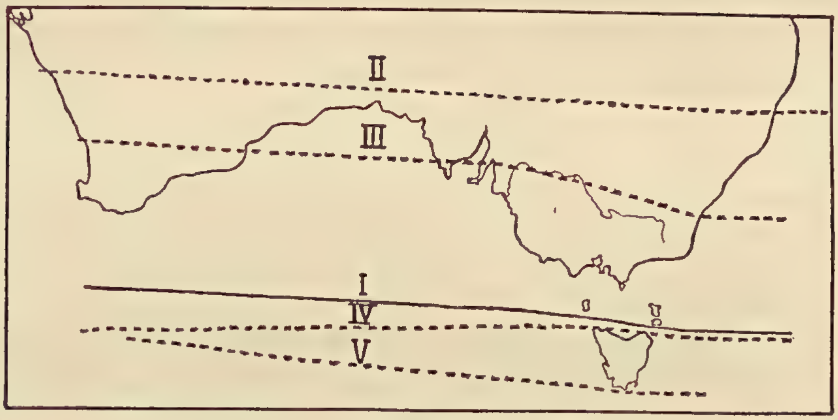

FIG. 3.

Approximate positions of paths of lows at present and in the past. I. During the six cool months (after Taylor, 1920, Fig. 132) and also 8,000 years ago; II. at last glacial maximum; III. 15,000 years ago when the tropical rain-forest reached Australia; IV. at Postglacial Optimum, 4,000 years ago; V. before existence of Bass Strait.

and about 250 fathoms deep flowing easterly. At Cape Leeuwin it is a surface current, but at Cape Northumberland it is about 150 fathoms below the surface and has cooled about 16 degrees.

Halligan (1921) states:

> The southern branch continues as an easterly surface current across the Bight, with a rate varying from ·3 to ·4 knot as far as Spencer Gulf. The warm current from the Indian Ocean, which appears to be confined to the Bight, to that point, here dips below and becomes partly merged in the main stream until it strikes the Tasmanian Plateau. This obstruction, by deflecting the current to the south-east, causes a further mixing of the warm and cold waters, which accounts for the water in Bass Strait being generally from 2° to 4° colder than the water off Cape Northumberland.

He observes that the Tasmanian Plateau also retards the current velocity in Bass Strait to the extent that the tidal currents become more important and that both are largely dominated by

the wind. The main body, however, sweeps along the western side of the plateau, turning sharply and with increased velocity to the east round S.W. Cape at the south-west corner of Tasmania. These are the conditions that have existed since the formation of Bass Strait, but before that, the whole volume of the current was diverted south-easterly along the western side of the plateau—the pre-Yolandean shoreline. The south-east corner of the mainland did not experience the climatic influence of that portion that now passes through Bass Strait, which, considering the temperature of the Southern Ocean Current is less than 62° F., must have been appreciable.

II. Rainfall: Fertility and Aridity.

The present rainfall-reliability belt is shown in Fig. 1; it is substantially that shown by Taylor (1920, Fig. 125). It extends from west to east across southern Australia to the Dividing Range, and north, for the most part, along the western slopes of the range into Queensland. The arid belt terminates against its western boundary and the reliable rainfall belt extends some 250 miles north of the line of maximum aridity (Fig. 1). Falling for the most part on the western slopes of the Dividing Range, the reliable rainfall is closely connected with the Antarctic lows travelling from west to east and is obviously mainly orographic.

The rainfall of the coastal corridor between the Dividing Range and the east coast, other than the cyclonic rain, comes mostly with the trade-winds that extend furthermost south in the summer months. The rainfall of the north portion of the corridor is seasonal. The corridor has always had a useful, if uneven, rainfall, particularly that part of it south of the Tropic of Capricorn; the number of permanent coastal streams draining is evidence of this. It connects northern Australia with south-east and southern Australia by a fertile belt—a fact plainly evident in the distribution of the white population.

During the last glacial period, the reliable rainfall extended along the western slopes of the Dividing Range to the Atherton Plateau in North Queensland (Fig. 13); this was the period of the greatest and most extensive fertility for eastern Australia. The rainfall-reliability belt receded slowly southwards until the Postglacial Optimum, but has since been moving northwards.

Such streams as the Diamantina and the Georgina flowing south had their sources in the extension eastwards of the Selwyn Highlands, a low physiographical divide that, owing to its trend,

does not intercept orographical rainfall. These intermittent watercourses, together with the south-west flowing Cooper, are outlets to the Lake Eyre Basin at the present time of from 15 to 20 inches of mostly summer tropical rainfall falling on the southern slopes of the Selwyn Highlands and on the western slopes of the Dividing Range. The effects of climatic change and the contraction of the rainfall-belt on these streams will be discussed under the heading Migration Routes (Part VIII).

In the tropical rain-belt, in Australia, there is a rain-forest comparable, as regards its ecology, with that in the Malay Archipelago and the Malay Peninsula; it is restricted to its northern part. The sub-tropical dry belt—the summer rain-region of Australia, savannah and grassland — includes, at present, a large portion of the north, south of the tropical rain-belt. On the poleward sides of the latter, in both Hemispheres, one passes into the arid belts, such as that in Central Australia, with slight or no rainfall. It is difficult to gauge the aridity of this in the past. At present the arid belt crosses Australia to south-west Queensland and north-west New South Wales to the edge of the rainfall-reliability belt; as already noted, it does not cross the latter into the coastal corridor. It includes the Lake Eyre Basin that normally receives less than 5 inches of rainfall, wholly convectional, but for periods of years no rainfall at all. Heat and consequently evaporation are excessive, the former not much less than the hottest parts of the Sahara (Kendrew, 1937), yet scarcely any of its western portion is true desert and is not as arid as some at the waterless west-coast deserts of other continents. Commenting on the desert-phase, Brooks (1926) states:

> In parts of the South American desert it has probably not rained for centuries. Such plants as there are show special devices to prevent the loss of water, but in many deserts the ground is entirely bare of plants. Among animals, one of the most characteristic is the lung-fish (*Ceratodus*), which is adapted to breathe either air or water, and can remain dried up for long periods.

Ceratodus is still living in Australia and is significantly found in what are now well-watered seasonal rainfall-tracts.

The gibber plains of Australia attest long and recurrent periods of aridity in the Quaternary. At the Postglacial Optimum the line of maximum aridity was through Marree, about 50 miles south of Lake Eyre, and the arid belt was then hotter and more arid. This hot period which was world-wide ended about 2,000 years ago and lasted about 4,000 years. Howchin (1913) believed the present arid conditions of Central Australia had a gradual evolution and were due to the sunkland in south Central Australia which had

the effect of raising the mean annual temperature. The increased temperature prevented rain falling on the advanced side of a barometric depression and limited it to the departing quadrant. These, he maintained, are the typical conditions of the rainfall of South Australia at the present time. He also attributes aridity to physiographical changes, but the writer has reason to believe that his conclusions are not supported by current research.

In the Lake Eyre Basin, the sub-surface deposits contain the remains of *Diprotodon,* crocodiles, chelonians and other forms implying wetter, moister conditions. The surface deposits accumulated during the warmer period of the Postglacial Optimum and have been transported thither by the spasmodic drainage accompanying convectional and seasonal tropical rainfall; the sub-surface deposits were deposited during the earlier part of the Postglacial or the last glacial period.

The effect of the hot period of the Postglacial Optimum is seen in the forests of eastern Australia. Taylor (1920) observes that many plants require rainfall all through the year, a break of a month or two being deleterious; this applies especially to the tropical forest element present along the east coast and south-east coast of Australia. He found that the 12 isopleth, which bounds on the west, the region receiving at least an inch of rain each month of the twelve, does not coincide with the limits of the thick tropical or temperate forest, so he plotted the line bounding the region where an additional inch fell during each of seven months on the regions of considerable rainfall. This was found to agree closely with the distribution of both the tropical and temperate forest. In this area, the rainfall practically equals evaporation and the required rainfall seems to be largely a matter of elevation; evaporation is a much more potent factor on the lowlands west of the highlands of eastern Australia than on the highlands themselves. During the warm period of the Postglacial Optimum the forests must have been much more restricted than they are today.

Southwards of the arid belt is the Mediterranean type of climate with an increased winter rainfall, but hot, generally rainless summers; this type passes into the temperate rain-belt. South of this is the boreal belt in which a terrestrial region is characterized by an ample coastal rainfall, but usually a dry interior; the winter is severe with a persistent snow cover and the summer is short. Evidence of it in Australia during the glacial period is seen in the peat deposits in southern Victoria and Tasmania; peat formation calls for a rainfall of at least 40 inches and a mean temperature above 40°F.

III. Deposits containing Artefacts.

The first appearance of the Proto-Indics or Australoids in Australia, in its present form, is of some antiquity; they came many thousands of years ago, but the time that has elapsed since their arrival is short compared, for instance, to that which has passed since the Neanderthal appeared in Europe. In reviewing here the stratigraphic positions of artefacts and the climatic changes disclosed by the sections, only the more reliable finds have been selected. One from outside Victoria has been included, Hale and Tindale's classic investigation at Tartanga and Devon Downs; it is felt that their evidence may be accepted without reservations and should be summarized here as many of the problems raised occur in Victoria. The Victorian records are less reliable; like many archæological discoveries nearly all of them were made by unskilled observers, but the evidence is at least as trustworthy as that of some accepted finds.

Little has been attempted in Australia in correlating the Recent or Postglacial and the Pleistocene sediments with climatic change. Archæological research in Australia has not as yet supplied the close subdivision worked out in Europe, nor are there any literary records or traditions to corroborate the more recent events: for these reasons the dating of them must always be an approximation. The bearing of climatic change in the Postglacial and Pleistocene has hitherto only been touched on in a perfunctory way and it is realized that the problems they raise can only be settled by marshalling more evidence; it is hoped, nevertheless, that their discussion may stimulate this. We are very much in the same position in Australia at present as they were in America when comparative records were not available there as to the conditions that prevailed before the coming of the white man. But a record of the climatic changes has been pushed back in America for 3,000 years by a close study of the growth-rings of trees. It has been said that the eucalypts do not lend themselves to dendrochronology like the American trees, but there is evidence of what appear to be largely climatic fluctuations in the former levels of lakes. Many of these lakes have no outlets and would appear to be suited to such an investigation. It is possible that by correlating the evidence they reveal with such as may be obtained from the study of growth-rings, a more or less reliable record might be obtained. One could not expect the comparative accuracy of the Caspian levels which are substantiated by literary and archæological records, but such a record would, nevertheless, be valuable.

A. *Evidence at Tartanga and the Devon Downs Shelter.*

This important investigation was conducted by Hale and Tindale (1930) who excavated the Tartanga deposits and the Devon Downs Shelter on the lower Murray, South Australia. They summarize the evidence of Tartanga, where there are human remains associated with food-debris and old industries, by the statement that the "geological and physiographical features show that these occupational records are at least of some antiquity." Because it throws some light on climate and supplies a standard for comparison, the Devon Downs succession is given here with that at Tartanga.

Devon Downs Shelter.	*Tartanga.*
I. Late Murundian. Hammer-stone, chippings, flakes, red-ochre.	I. Signs of human occupation. A few hand-mills, no definite stone artefacts. A few stone chippings.
II. Murundian. Human remains, bone implements, stone chippings, red ochre.	H. Numerous signs of intensive occupation, hearths, ash, etc.
III. Murundian. Human remains, bone and stone implements of indefinite type.	G. A single flake, exhibiting what may be poor attempts at secondary chipping.
IV. Early Murundian. Human remains. Bone and stone implements of definite shape.	F. A crude millstone.
V. Mudukian. Bone implements and definite stone implements similar to VI and VII.	E. Human remains. Bone implements. Stone chippings.
VI. Mudukian. Human remains. Bone implements including *muduk* or fishing-bone. Stone implements.	D. Human remains. Implements, millstones, pounding and grinding stones, chippings.
VII. Mudukian. Bone and stone implements.	C. Human skeleton. Stone implements and chippings.
VIII. Pirrian. Typical stone and bone implements including *pirri.*	B. Burnt stones, stone chippings or flakes. Bone implements.
IX. Pirrian. Stone and bone implements including *pirri.*	A. Burnt stones suggestive of cooking-hearths.
X. Pirrian. Stone and bone implements, including *pirri.*	AI. Occupational debris.
XI. Pre-Pirrian. Human remains. No stone implements but chippings. Bone implements.	A2. Occupational debris.
XII. No implements either bone or stone. Chippings.	

In the succession at Tartanga, the term Tartangan is restricted to the period during which beds E to A were deposited, except AI and A2, the oldest of the series. Hale and Tindale consider the

sequence, in ascending order, to be Tartangan, Pre-Pirrian, Pirrian, Mudukian, Murundian, the first-mentioned being separated from the rest by a time-interval of unknown duration.

The sequence with the salient faunas is tabulated

Culture-phases	*Site*	*Salient fauna.*	*Industries*
Late Murundian	Devon Downs I	All are existing species, *Unio vittatus. Melania* much more abundant than *Bulinus.*	Degenerate stone culture. Rock-markings, Type C (illustrated).
Early Murundian	Devon Downs II to IV.	All are existing species of animals *Unio vittatus.*	Degenerating stone industries; adze-stones (*tula*) common only at beginning. Bone artefacts very rare. Rock markings, Type B (illustrated).
Mudukian	Devon Downs V to VII	Small mammals numerous. *Sarcophilus* cf. *harrissi. Unio vittatus.*	Rich stone and bone industries including *tula* and double-pointed bones (*muduk*). Rock markings Type A (illustrated).
Pirrian	Devon Downs VIII to X	Large mammals common *Sarcophilus* cf., *harrissi Chelodina* cf. *expansa, Unio vittatus.*	Rich stone and bone industry. *Tula* rare in upper and absent from lower layers. Leaf points (*pirri*) abundant. Double-pointed bones (*muduk*) absent.
Pre-Pirrian	Devon Downs XI to XII	*Bulinus* much more abundant than *Melania, Unio vittatus.*	Scant bone industry. Stone chippings, but no implements recovered. Not well known.
Tartangan	Tartanga beds. A-E.	*Unio protovittatus.*	Stone and bone industry. Large patinated, discoidal scrapers, coarsely retouched. Coarse bone implements.

Hale and Tindale collected the molluscan shells in the food debris at the Devon Downs Shelter all of which they point out, were brought there. The number of shells of a species found on a cultural level is taken by them to indicate the relative abundance or scarcity of the species in the vicinity at the time, and they show this by a graphical representation of about a thousand specimens of *Melania balonnensis, Bulinus texturatus* and *Corbicula angasi.* They show that *Melania balonnensis* is rare in the lowest layers but in the highest more plentiful; *Bulinus texturatus* and *Corbicula angasi* are plentiful in the lower layers, the former very plentiful, and rare in the higher layers. Incidentally *Melania* is found in the clays with the bones of *Diprotodon* at Lake Calla-

bonna east of Lake Eyre, and is well represented in the warmer rivers of Queensland; Hale and Tindale suggest that its distribution in the layers at Devon Downs implies climatic change "in the direction of the semi-arid conditions of the lower watershed of the present time." The author is of the opinion that the arid conditions at the time of the Postglacial Optimum are indicated. *Bulinus* is a fresh-water genus most abundant in Layer XI (Pre-Pirrian) and its distribution is taken to suggest the cooler climate of the Postglacial that prevailed previous to 8,000 years ago. The relative abundance of the three molluscs seems, therefore, to support the Postglacial climatic changes emphasized here. If the chelonian in Layer X was actually *Chelodina expansa,* such would be inconsistent with them, for that species is only found in northern Australia; it is, however, only compared with *C. expansa.*

It would seem from the physiography of the Lower Murray that all the industries and cultures of Tartanga and Devon Downs belong to the Postglacial period. They have certainly been deposited during a period of accumulation succeeding a period of removal, presumably the vertical erosion accompanying the lowering of sea-level during the last glacial period. That being so, they are certainly Postglacial.

B. Artefacts Associated with Dunes.

Altona Bay is on the north-west shore of Port Phillip Bay, the dune area there extending 3 or 4 miles south-west along the shore from the Kororoit Creek and 1½ miles inland. It has been described and mapped in detail by Hills (1940). Extending along the shoreline is a beach ridge and inland behind this are ridges (referred to here as the inner ridges) of intercalated dune-sand and shell-beds 4 to 5 feet above the floors of the intervening swales. The contained shells are all living species and well preserved; some of them have paired valves. The shell-bed showing in the cutting on the Altona railway line about 200 yards west of the Kororoit Creek, is 8 feet thick and its upper surface is about 9½ feet above L.W.M. (low-water mark at Hobson's Bay—the datum usual in Victoria); it rests on the lava-plain-Newer Volcanic Basalt (Middle Pleistocene). Some layers in it are almost entirely composed of shells, others of fine, loose sand with shells and travertine. Pritchard (1909) states that "there is no hesitation in saying that the shells are marine but occasionally a layer of brackish water shells composed of such genera as *Truncatella, Coxiella, Assiminea, Salinator* and *Ophicardelus* make their appearance." The water in which the beds were laid down was, seemingly, in close proximity to a shoreline.

In the swales there is a small accumulation of sand from the disintegration of the ridges since they were formed. Inland behind the inner ridges are ephemeral lakes—Lake Seaholme, Lake Altona, and Lake Truganina—the bottoms of which are black mud resting on the lava-plain. In the banks of Lake Truganina, 5 feet 9 inches above L.W.M., are marine shells *in situ;* some of the pelecypods are paired. The lower reaches of the Kororoit Creek flow over a similar mud in which marine shells occur. Marine shells are also found in the tidal deposits slightly above present high-tide level on the flats north of the Williamstown Racecourse which is on the right bank of the Kororoit Creek.

The highest inner ridge shown by Hills (1940 Fig. 3) is 10 feet 2 inches above high-tide level, or, as the tidal range at Altona is about 2 feet, 12 feet 2 inches above L.W.M. It is apparent, then, unless there has been very recent subsidence, the inner ridges were submerged to a depth of from 3 to 8 feet by the Recent or Postglacial rise of sea-level of from 15 to 20 feet above present L.W.M. This inundation also filled the lakes behind the ridges. Recent subsidence cannot however be discounted, for the writer (1946) believes that the coastal strip on the eastward side of a line from Footscray to Werribee and beyond is a down-warped area partly responsible for the recent configuration of Port Phillip Bay.

Submergence during interglacial periods has occurred on the Nepean Peninsula, the south-eastern land arm of Port Phillip; there dune-deposits have been levelled and sediments and shell-beds deposited on their levelled surfaces. The succession at Altona is taken to be:

A.—Newer Volcanic Basalt (Middle Pleistocene).

B.—Margaret glaciation period.
- a.—Emergence (W2).
- b.—Submergence (W2/W3). Deposition of shell-beds.
- c.—Emergence (W3). Formation of dunes.

C.—Postglacial.
- a.—Rise of sea-level, progressive submergence and levelling of dunes.
- b.—Maximum rise of sea-level from 15 to 20 feet above present L.W.M. at Postglacial Optimum.
- c.—Progressive emergence. Dunes uncovered with levelled surface, commencement of formation of beach ridge.

The symbols W2, W3 and W2/W3 represent the Wurm glacial and inter-glacial stages.

If sea-level started to recede 4,000 years ago and it has fallen from 15 to 20 feet at the same rate since, the inner ridges at Altona emerged from 2,400 to 3,200 years ago.

Point Cook, where there is evidence of inner ridges and swales, is topographically and apparently structurally like Altona. The basal bed consists of fluviatile deposits at the mouth of the Skeleton Water Holes.

Both Altona and Point Cook have been prolific collecting grounds for all kinds of stone artefacts. Altona is a growing suburb of Melbourne and the opportunities are fast disappearing; it is deplorable that so few records of the positions of artefacts when they were found have been kept. Enquiries suggest the probability that they were on the surfaces of the inner ridges or the floors of the swales. It will be realized that if any were *in situ* in the surface sand of the inner ridges, such would be evidence of the presence of the aborigines during the last glacial period or the opening stages of the Postglacial. It is obvious from the parallel bedding of the ridges that the whole area was formerly covered by these bedded deposits and the swales responsible for the ridges were formed later. Whether or not the implements found on the floors of the swales were incorporated in the material that has been removed must remain an open question. An intelligent search of the upper sands of the inner ridges would be informative.

At Point Cook, the artefacts are found on the dunes or on the basal bed where it has been exposed by the shifting of the dune-sands. Whether those on the basal bed have been let down on to it by the removal of the dune-sands, or were there before the dune was formed, cannot be determined. The extant native fire-places in the dunes consist of a subcircular collection of fire-stones so placed by the aborigines; they occur at all levels. Where the dune-sand on which a fireplace rested has been shifted by wind action from under it, the stones are scattered, but many fireplaces retain their original shape. At one place the author observed one that had been placed on the basal bed. The fact that they occur at different levels might be taken as evidence that the aborigines were there throughout the whole dune period and even before, but there is the possibility that they selected a depression, or made one, in which to place their hearths; if so, they could be readily covered by drifting sand.

Summarizing these notes, up to the present, the evidence at Altona and Point Cook points to the earliest occupation of those areas by the aborigines about 3,000 years ago, when the inner ridges at Altona were first uncovered. The beds in the areas

require investigation by intelligent collecting for evidence of an earlier occupation; such, whether it was positive or negative, would be valuable.

The artefacts found at Altona and Point Cook, on the evidence available, belong to the Murundian, the newest of Hale and Tindale's industries.

C.—Deposits under Lava-flows and Volcanic Ejectamenta.

In Victoria, artefacts have been found under lava-flows and volcanic ejectamenta. Much of the evidence must be accepted on its face-value, for most of the finds were made more than half a century ago. They were found at widely separated places by individuals who, with a single exception, did not realize the significance of their finds: the thought of antiquity never occurred to them. Where possible inquiries have been made by the writer and statements checked. It has been ascertained, for example, that they who were connected with the finding of the Pejark Marsh Millstone (p. 46 *post*) were trustworthy and all of them lived in the locality at the time. It was not possible to locate those who found the Buninyong Bone (p. 50 *post*) but the writer knew the Hon. R. T. Vale who was the parliamentary member for Buninyong towards the close of the last century and chairman of the Board of Directors of the Great Buninyong Estate Mine; he resented any implication that the bone had not been found in the circumstances stated, or that it had been tampered with. The Maryborough Axe was found in 1854. Its authenticity cannot be probed, but it was facetiously queried by a boring engineer who visited the site some 50 years later and gave it as his opinion "that it might have fallen down a wombat hole or a natural hollow." The Colongulac Bone was picked up on the shore of Lake Colongulac together with a number of other bones, including some of *Diprotodon*; it came from a bone-bed that has not yet been located, but is known to occur in the immediate vicinity. There is ground for the belief that the bed is contemporaneous and probably identical with that at Pejark Marsh. Spencer and Walcott (p. 51 *post*) were convinced of the genuineness of the Colongulac Bone. The section from which the Bushfield Axe is stated to have come was inspected by S. R. Mitchell and myself (p. 56 *post*): E. W. Hamilton, who found it, is, too, an untrained observer and his account must also be taken at its face-value. The sole instance of a discovery of implements by a competent and reliable observer was the finding of the Myrniong artefacts (p. 54 *post*) under "The Island" lava-flow; their authenticity cannot be doubted.

The volcanics of western Victoria may be considered under two headings—the earlier lava-plains phase and the recent scoria-cone phase, the latter comprising scoria, scoria-cone lava-flows and tuff.

The lava-plains or lava-field phase extends westwards from the meridian of Melbourne to near the western Victorian border; it is bounded on the south by the Otway Ranges and further west by the Southern Ocean, the coastline of which is fringed with dunes. It extends northwards almost to the Dividing Range in its former position. No artefacts have been found under it, but an understanding of its place in regard to the scoria-cone phase is desirable.

The scoria-cone phase is, from the standpoint of archæology, highly important, for under some form of it have been found the Pejark Marsh Millstone, Buninyong Bone, Maryborough Axe, Bushfield Axe, and the Myrniong implements. The most comprehensive survey of both of these volcanic phases is that by Grayson and Mahony (1910) who mapped in Quarter Sheets 8 N.E. and 8 N.W. (New Series) over 580 square miles and described the area. The legend of these Quarter Sheets does not give geological ages for any of the features mapped other than the basal marine sediments on which the lava-plains rest. The legend given in Fig. 4 is compiled from their statements and our own observations.

Age	Quaternary Periods	Soils, Clays, Tuffs and Gravels			Volcanic Phases	Climate and Rainfall
RECENT	Postglacial	Black alluvial soil Dunes of quartz sand and redeposited tuff Hampden tuffs Black clay containing wind-blown sand and tuff Diprotodon Bed Yellow clay of wind-blown sand and tuff Buckshot gravel	Surface flood-plain ↑ Sub-surface flood-plain	Surface lacustrine ↑	scoria cones, scoria cone flows & tuffs	increasing rainfall arid period postglacial optimum decreasing rainfall
PLEISTOCENE	Margaret glacial		↑	Sub-surface lacustrine		cool, rainfall period
	Yolande-Margaret Interglacial	Buckshot gravel	Vertical erosion			increasing rainfall arid period decreasing rainfall
	Yolande				[lava plain]	cool, rainfall period

FIG. 4.

Legend compiled from Quarter Sheets of Camperdown and Mt. Elephant Districts.

Grayson and Mahony state that the scoria-cones and scoria-cone flows are of very recent origin, and though they are "approximately of the same age, some of the flows are no doubt considerably older than others, and no sharp line can be drawn between them and the earlier [lava-plain] basalts." Nevertheless, that there is

a time interval between the scoria-cone phase in the Camperdown district and the lava-plains, is evident from the fact that while no scoria-cone flow shows sign of fluviatile dissection, the stream-system on the lava-plains is mature.

Earlier accumulations of the Hampden Tuffs, a tuff-series so-named by Grayson and Mahony, cover extensive areas near Camperdown and Lake Keilambete as well as the floors of Lake Bookar and Lake Terang. Since it covers the floors of these and other lakes and swamps, their basins were formed either during or before its accumulation. Its earlier phases are distinct from the scoria and scoria-cone lava-flows which in places rest on it, while it in turn rests on the mature topography of the lava-plains. The time taken for the lava-plains physiographical cycle to reach maturity is the interval between the accumulation of these earlier phases of the Hampden Tuffs and the extrusion of the lava-plains.

That the final accumulations of the Hampden Tuffs are quite recent, is shown by their position in the Pejark Marsh section (Fig. 5) where the series is covered by only 3 feet of soil; there it is only 2 feet thick and the attenuated edge of a thick series of tuffs on the slopes of Mt. Terang (*cf.* Walcott, 1919), it rests on black clay which rests on yellow clay that also contains volcanic ejectamenta. The texture of this yellow clay suggests that it was deposited during the the arid period of the Postglacial Optimum, and the black carbonaceous clay resting on it was deposited after the Postglacial Optimum. From the evidence afforded by the beds in the Pejark Marsh section, it appears that the scoria-cones in the area were active during the arid period and spasmodically during the increasing rainfall period up to less than 2,000 years ago, when, approximately, the Pejark Marsh Tuff accumulated.

Gill (1943) points out that the tuff at Warrnambool is of very recent age, and gives as part of his evidence that it rests on Holocene shell-beds which means that the tuff is later than at least the beginning of the Postglacial recession of the sea (if the 15-foot relative rise of the land at Warrnambool is due to this cause). The writer, on the other hand, believes (p. 58 *post*) that the Warrnambool tuffs accumulated earlier in the more recent half of the Postglacial.

The Hampden Tuffs, in most places, rest on buckshot-gravels of lateritic origin formed during the tropical and subtropical climates of the arid periods of the Postglacial and interglacial stages. The flood-plain deposits of the mature Emu Creek are at no place covered with scoria, a scoria-cone flow or tuff; they seem to have been at all times beyond their reach.

The lacustrine sediments in some of the oldest depressions on the lava-plain have been accumulating since the lava-plain was formed. The flood-plain deposits commenced to form after these older depressions were connected up by the dissection of the lava-plains, and continuous drainage channels formed; it is possible that some of the sub-surface flood-plain deposits rest on the earlier lacustrine deposits. As both lacustrine and flood-plain deposits are still accumulating in places, the surface deposits of each are Recent and contemporaneous; below the surface parts of each are also contemporaneous but their respective positions in terms of footage are in no-wise comparable. Lacustrine sediments on this area are mainly composed of wind-blown material and accumulate at a much slower rate than the fluviatile sediments: a few feet of the first may be represented by many feet of the second—there is no way of equating the deposits except at the surface.

The valleys of the mature topography show some evidence of terracing, but these have not been correlated with any Pleistocene eustatic levels. From the mouth of the Hopkins River to Cape Otway, the coast is a young, receding one, with cliffs up to 100 feet high of horizontal Tertiary beds capped with dune-limestone. On the face of these cliffs are remnants of the 15 to 20 feet Post-glacial raised beach, but the Pleistocene shorelines have either been removed by erosion or are submerged under the waters of the Southern Ocean.

Included here with the scoria-cone phase are the confined lava-flows that extend as tongues down valleys falling both north and south from the Dividing Range in its present or former positions. Most of these flows belong to the scoria-cone phase, but, where the lava has poured on to the lava-plains from the scoria-cones, it is difficult to distinguish it from the older flows.

The facts concerning the discovery of the Pejark Marsh Mill-stone were stated by Spencer and Walcott in their unpublished manuscript on early man in Victoria (1914 *circa*). As they made personal contact with the finder who gave them all the particulars, they were best fitted to describe the circumstances of the find and to form an opinion as to its authenticity. Their remarks are quoted *in extenso*:

In the beginning of February 1908 we received from Mr. A. J. Merry of Terang, a letter in which he states "I am forwaring some bones and what I think is a stone implement I unearthed in an excavation for a concrete culvert, over a drain, half a mile from the township (Terang) and 2½ miles this side of Mount Noorat. . . . . The excavation was about 10 feet deep from the natural surface, and consists of 3 feet soil, 2 feet solid sandstone, 3 feet black clay, 2 feet yellow clay, as far as I had to go down. Through the whole length of the

trench—69 feet—in the yellow clay were pieces of bone in nearly every shovel full, samples I am forwarding you. [Mr. Merry says in letter 23 July '09 that bones also in last foot of black clay.] I have been told by men who excavated the drain in the first place, that from end to end about 2 miles in length, they took out bones in cart loads and all in the clay, some feet under the sandstone." . . .

In reply to questions Mr. Merry adds, "The implement was embedded with the bones in the yellow clay, it was impossible for it to have fallen in from the overlying beds and I was very careful with it, as when I struck it with the shovel I thought it was a large bone, and wanted to get it out without breaking it. It was 3 feet in from the bed of the drain, and 2 feet below same in the solid clay under the sandstone 3 feet in width which I had cut away." In a later letter he states "I showed it to Dr. Breaton [*sic.*] in its rough state at the works with the yellow clay adhering to it, and he did not notice that it was an implement. I then took it home and washed all the clay off it, and could see that it was a piece of stone implement." Mr. Merry also states that well sinkers have found bones at depths of over 100 feet under the "sandstone" bearing out his experience quoted before. Mr. R. Harvie, one of the men who worked in the opening of the drain in the first place, informed Mr. Merry that he dug up a stone implement, said to be a grindstone, about a chain below the culvert, 9 feet from the surface, which is about the top of the yellow clay, and 4 feet below the "sandstone." He also told Mr. Merry that they dug up a "Petrified Skull" with the teeth intact, but they placed no value on it, and after knocking the teeth out, threw it on one side. This skull was found about 100 yards to the west of the culvert with a number of fossil bones just on top of a bed of "buckshot gravel" about 5 feet under the "sandstone" . . . . In another letter Mr. Merry writes "Whilst removing some clay I had previously thrown out from the excavations I came on another broken implement, this time of a dark blue colour. . . . I missed seeing it when I first threw it out, I think it must have been in a big spit, and the clay all round it hid it from my view." Although he does not know what part of the trench it came from he is positive it came from below the sandstone. It should be mentioned here, that the sandstone Mr. Merry refers to is not sandstone but a compact bedded tuff which is locally known as sandstone.

We have no reasonable cause to take exception to the authenticity of the first implement found by Mr. Merry. He is a man whose statements are reliable and who had, moreover, no knowledge of the interest attached to the discovery, and personal enquiries only bore out the correctness of his statements. The only doubt then must be as to whether the implements could possibly have fallen in the trench from above. Mr. Merry is most emphatic that such was not the case and as the bottom of the trench was lower than the drain and bones were also found with the implement there can be no doubt that the ground has not been disturbed since their deposition. . . .

The other implement found by Mr. Merry and described by him as being of a "dark blue colour" is formed of a small boulder of fine-grained laminated basalt. It weighs about 3¼ pounds and represents roughly a little more than half the boulder. It has been roughly chipped on both sides of one end to produce a rough cutting edge, forming a by no means uncommon implement called by Messrs. Kenyon and Stirling in their scheme of classification an axe chipped on both sides. With the exception of a fracture made by Mr. Merry, the surface is of a dull light bluish-grey colour, due to weathering. The variety of basalt is quite distinct to that occurring locally and the fact that the implement has been made from a boulder proves that its source must have

been the sea coast or a distant watercourse. Its antiquity would be quickly disposed of if the origin of the stone were known for the newer lavas of the Hampden [area] are in all probability younger than the tuffs. As, however, the implement was not found *in situ* it cannot be used in support of the antiquity of man in Australia . . . . .

The following is a composite section based on observations by Merry, Spencer and Walcott, and the writer.

FIG. 5

Composite Section of Excavations made near drain in Pejark Marsh.

Pejark Marsh is an irregularly shaped fresh-water swamp that has been drained, about 440 feet above sea-level, in a depression between the scoria-cone of Mt. Noorat (1,026 feet) about 1½ miles north of it, and Mt. Terang about 40 chains south of it. Before it was drained, it was covered with thick ti-tree scrub and eucalypts. To the east and west, the surface is covered with buckshot-gravel, and there is a narrow strip of buckshot gravel on its northern margin where the scoria-cone flow from Mt. Noorat almost reaches the Marsh. On its southern margin are the lava-plains basalt and Hampden Tuffs.

The country surrounding the Marsh is generally flat, Mt. Noorat and Mt. Terang providing the only relief. No streams have at any time emptied into the Marsh and the water it contained was the rainfall that fell over its restricted basin. The surface-soil and black clay are rich in carbonaceous material indicating the

existence, when they were formed, of a swamp-flora flourishing in a climate with moderate rainfall; on the other hand, when the yellow clay was deposited these conditions did not exist and no carbonaceous matter was found in it.

In 1908 Spencer and Walcott (1911) made an excavation near where Merry reported his find in search of implements but found none. The succession passed through confirmed that reported by Merry.

With the same object in view, it was decided to seek the permission of the Shire of Camperdown to put down a hole near Merry's original site. Mr. Rooney, the Shire Engineer, instructed Mr. Blackburn to do this for the Museum. The site selected was in the drain on its northern sloping bank on its south side, a few yards from the old culvert and between it and the new one over which the stock-route passes.

The hole for the Museum was put down early in 1947. Except that the thickness of the beds varied, the succession confirmed that given by Merry and Spencer and Walcott and shown in the composite section (Fig. 5). At the bottom of the black clay, the bone-bed was passed through and in it a molar, a lower incisor, and part of the diastema of *Diprotodon australis* (Owen) were found. Elsewhere, the writer (1945) has placed the *Diprotodon* bed of Grayson and Mahony above the Hampden Tuffs but here it is, at least apparently so, below part of them. In the lower layers of the tuff itself numerous examples of the reed *Cladium tetragonum* (Lab.), the black, square Twig Rush, were identified by J. H. Willis, of the National Herbarium; their presence had been previously noted by Walcott (1919). Pressed against the bedding-planes, their method of preservation suggests that they had been flattened under successive accumulations of tuff, and although the explosions responsible for the bed of tuff occurred over a relatively short interval of time, they were spasmodic. In one of the lower layers of tuff a fossilized insect larva was found; this was identified by A. N. Burns, Entomologist to the National Museum, as approximating to *Oxycanus fuscomaculatus* Walk. It was replaced by a fungus also identified by Mr. Willis as *Cordyceps* cf. *lavarum* Olliff, the mycelium of which permeated its tissue and facilitated fossilization. During the accumulation of the tuff, the swamp-depression, although damp—the reeds evidence this—apparently seldom held up water. To permit of the metamorphosis of *Oxycanus,* the floor of the swamp must have been exposed in May and June, at present wet months in this region; the loose aggregation of the tuff seemingly made it extremely porous.

Mrs. Sylvia Whincup, Mineralogist to the Museum, separated out the minerals composing the yellow clay. Quartz-grains were common, the larger well rounded, the smaller angular; clear quartz was abundant and reef-quartz common. Other minerals present were magnetite, olivine, and volcanic glass indicating that a scoria-cone was in action while the clay was being deposited. She also found zircon, tourmaline, and rutile—minerals that have obviously been transported from some distant source. In view of the fact that no streams now enter, or have entered Pejark Marsh in the past, one can only assume that these minerals are wind-borne. A small microscopic freshwater shell found in the clay may have had a similar origin.

The Pejark Marsh succession is typical of surface and sub-surface transported deposits on other parts of the lava-plain. The records of a number of bores put down through such, show that the surface to some depth consists of dark or black sediments under which is a yellow clay.

Howitt (1904) attributes to James Dawson the tradition of the aborigines of western Victoria that fire came out of a hill near Mortlake, and "stones which their fathers told them had been thrown out of the hill by the action of fire." If there is an historical background to the tradition, Mt. Shadwell is the nearest scoria-cone to Mortlake, but Noorat, Keilambete, and Terang are all vents not far distant.

Summarizing the evidence that has accumulated in connection with the Pejark Marsh Millstone, it may be confidently stated that it is of Recent or Postglacial age. The yellow clay in which the Millstone was found is covered by black clay, bedded tuff, and soil, that have been deposited up to the present time without a time break, but there may have been a short time interval between the yellow clay and the overlying black clay. Estimated by the measure of climate, the millstone is less than 3,000 years old, having been covered by the wind-borne material at the concluding phase of the arid period of the Postglacial Optimum. It belongs to some horizon of the Murundian in Hale and Tindale's succession (*supra* p. 38).

The Buninyong Bone (Plate 2, Fig. 8) was found in the Great Buninyong Estate Mine at Buninyong, near Ballarat, towards the close of last century. Apart from the question of its authenticity, a doubt persists as to whether it is an implement and has been fashioned by man.

Kenyon (1936) claims to have examined it "while it was still in a fairly fresh state." He condemned it because it had no

semblance to a bone-implement made by the aboriginal and "probably not by any more primitive forerunners." He states that "the cuts were manifestly made by a steel-edged implement, such as a shovel, which crushed and broke crystals of pyrites filling the interstices of the cancellous tissue. This was conclusive proof that the cuts had been made after pyritization of the bone, which must have taken place after immersion in the sub-basaltic river gravel and the contained mineralized waters." Kenyon made this statement 34 years after De Vis, who saw the bone in its original condition, had declared it was an implement fashioned from a portion of a rib of a *Nototherium* (De Vis, 1900). De Vis was an authority on the cuts made on bone by predatory animals and he examined closely the nature of the cuts; he did not refer to the state of the pyritic impregnation. Spencer and Walcott (1914 *circa*) also specialized in cuts made on bones by animals and they state that they were convinced that some of the cuts were the work of *Thylacoleo,* but others were not. They state that "the late Dr. A. W. Howitt, who had the opportunity of seeing the Buninyong Bone before it was coated with size to preserve it, informed one of us that he was quite satisfied that none of the marks were of recent origin, and that they had one and all been made before the bone was deposited where it was discovered. This statement of Dr. Howitt's seems to be correct from the general aspect of the marks, and Mr. De Vis has corroborated him by making a cut in the bone himself for comparison." They scout, too, the suggestion by Gregory (1904) that the bone may be the result of an accident, the shovel of one of the miners having possibly cut into the bone and broken it where it was lying in the silt, the shovel at the same time having driven mud into the cut-surface thus hiding its recent formation. Anyone who has carefully studied the bone, they say, could not possibly give any credence to such an explanation "for the shovel has not yet been invented which could produce accidentally marks of this kind." But they consider that the fact that there is no record concerning the whereabouts of the bone from the time it was found until it came into the mine manager's hands is a flaw in the chain of evidence regarding its authenticity.

De Vis thought the implement was a scraper but Spencer and Walcott considered it extremely doubtful that the specimen was ever intended for use: Howitt expressed no opinion as to its purpose.

The section in the Great Buninyong Estate Mine shown in Fig. 6 was compiled from particulars given by Hart (1900).

He states that the lava-flows from Mt. Buninyong that covered the lacustrine clays need not be of any great age. That the clays are quite recent is evident from the fact that the Buninyong Bone was a portion of the rib of *Nototherium;* the bones of *Nototherium* are sometimes found under a scoria-cone flow but never under the older flows of the lava-field or lava-plains. Mt. Buninyong is a scoria-cone from which the lava Hart mentions flowed down a valley that formerly emptied its drainage into the Murray but was later reversed and became part of the drainage-system to the Southern Ocean. The black, lacustrine clay was deposited in a depression which was covered by the lava; the age of the clay is nearly that of the overlying scoria-cone flow. The black clay was

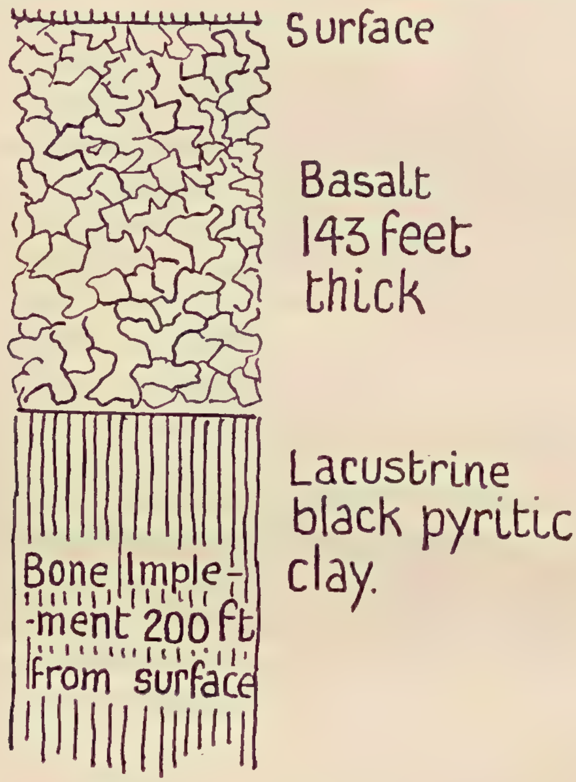

FIG. 6
Section in Great Buninyong Estate Mine.

deposited during a period when the rainfall was great enough to support a humus-forming vegetation. Such conditions prevailed during the earlier part of the Postglacial and the last glacial period. The yellow clay of Pejark Marsh is not present in the Buninyong section, and the black lacustrine clay appears to have been covered by the scoria-cone flow before the dry period of the Postglacial Optimum.

Lakes such as that in which such lacustrine deposits formed have been common in the district but most of them have been emptied by the breaching of their perimeters. Baragwanath

(1923) states that west of Mt. Buninyong, in the Yarrowee Creek valley "a small lake was formed against the basalt . . . its surface showing at about the 1,290 ft. contour at one period; whether it was the original limit cannot be settled. Abundant chips such as are found at the sites of aboriginal camping-places occur along the former shore-line, and clearly mark points where the natives congregated, but above or below this limit the chips are rare." Mr. Baragwanath took the writer to the locality but it has, since the former made his observations, been planted as a pine forest and the evidence is not now obtainable.

It is interesting to note that Howitt (1904) states that there was an aboriginal tradition "that Mount Buninyong had at a distant time thrown out fire."

On the scanty evidence available, the Buninyong Bone possibly belongs to the Tartangan of Hale and Tindale's industries (*supra* p. 38).

In 1855, A. C. Swinton and M. C. Shore sank a shaft near the town of Maryborough, Victoria, in one of the heads of the tributaries of the so-called Bet Bet Lead. A lead is the lowest fluviatile deposit in an old river-valley usually covered by later fluviatile deposits but often with lava. The Bet Bet Lead was formerly thought to occupy a single trunk-valley having an outlet to the north-west, but it has since been found to consist of two valleys falling in opposite directions, one towards the Avoca Lead, the other towards the Berry-Moolort-Loddon Lead System.

Swinton and Shore's shaft was sunk for a depth of 5 feet to "bottom," presumably Palæozoic bedrock. At a depth of 4 feet from the surface, Shore drove his pick into a basalt axehead (Howitt, 1898). The shaft had passed through a hard band of cemented gravel and also three "false bottoms." A false bottom is a stream level above the lowest fluviatile deposit at which former fluviatile deposition has occurred. The presence of three of these in a depth of 5 feet below a surface deposit accumulating at the present time, points to three very recent, short-lived cycles of erosion. We are not told whether the axehead was in false bottom material, but the shallow depth involved and the position at which it was found, suggest this.

It is not possible now to pin-point the shaft on a map, although for our purpose, its position in relation to the local physiographical divide is important. If it was on the west of the town, the fluviatile sediments belong to the westerly stream-system; if on the east of it and in a tributary flowing northerly or easterly, they are part of the eastern stream-system. Both these systems

formerly emptied into lakes and the sediments now covering their lower reaches are covered with lava. The scoria-cone flow over the western one is evidently very recent, for the subsequent streams have not yet become marginal streams; the lava in places is a narrow flow that appears to have occupied a small gutter cut in fluviatile deposits. The lava covering the sediments over the eastern trunk-stream appears, on the other hand, to be older, for fairly mature lateral valleys have been formed along its margins. Some of the tributaries of this eastern trunk stream have been dammed back by encroaching lava, a lake has been formed, and lacustrine sediment deposited on the tributary flood-plain. Such has occurred at Talbot (Back Creek) 8 miles to the south, where the remains of *Diprotodon* were found supposedly in diatomaceous lacustrine deposits (Keble, 1945).

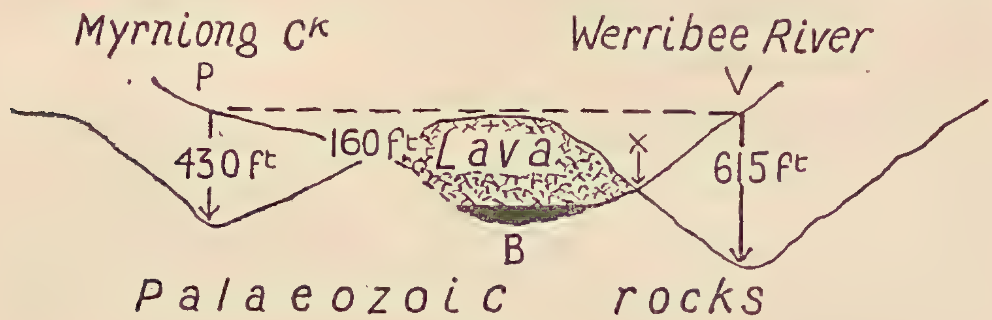

FIG. 7.
Section through The Island, Myrniong.

The absence of information as to what bed the axehead came from makes its age uncertain but the geological history of the area indicates the Recent or Postglacial.

The Myrniong implements from The Island, 6 miles N.W. of Bacchus Marsh, were found in a bed of gravelly clay (X, Fig. 7) 18 inches thick underlying basaltic lava, by C. C. Brittlebank, Government Plant Pathologist, who was also a skilled and reliable geologist. The Island is so-called because it is a high lava-residual almost separated from the rest of a scoria-cone flow by the deep erosion of marginal valleys, the streams in which almost junction at its north-west end and actually become confluent to the south-east of it. A section of the lava-residual is shown in Fig. 7.

The pre-basalt valley, PBV in Fig. 7 was filled with basaltic lava to the level PV after which, to find an outlet, the drainage started to erode in the less resistant rocks at P and V, channels that have developed into deep marginal valleys. That developed at P, the Myrniong Creek, is now 430 feet below the original sur-

face of the infilling basalt, and that at V, the Werribee River, 615 feet below it.

It is apparent, and Brittlebank realized this, that if the rate in years of the erosion of the marginal valleys could be determined, it would be possible to ascertain the age of the basalt, and with it the age of the gravelly clay and the age of the implements. He experimented (Brittlebank, 1900) by inserting short lengths of wire in holes bored in the rock at the bottom of each of the valleys and recorded the times when a particular length was exposed. He obtained a rate of erosion of 0·58 in. per century, which, applied to the mean depth of both valleys, gives an age of over a million years. Apart from the crudity of the experiment, which ignores a number of factors, the main objection is that it was conducted at a time when the rate of erosion was near its minimum—a short lapse of time after the Postglacial Optimum. The rate of erosion had consistently decreased up to that time, and its mean was formerly very many times greater than the figure obtained by Brittlebank.

The basaltic lava of the Bacchus Marsh district issued either to form extensive lava-fields, or scoria-cone flows that occupied pre-existent valleys, at various times from the Middle Pleistocene (Keble, 1946) up to a recent period in the Postglacial. Those of The Island were scoria-cone flows having their main source at Mt. Blackwood (Fenner, 1918). They infilled the channel PBV, the middle reaches of a valley that opened, about a mile S.E. of Rowsley, on to the Werribee Plains lava-field. Across this opening is the Rowsley Fault trending S.S.W. Fenner (1918) gives sections across the fault showing the displacement or otherwise due to it. Near Dog Trap Gully, east of Rowsley, about where the Island flows debouched on to the Werribee Plains lava-field, he shows (*sup. cit.* Figs. 7, 8b). The Island scoria-cone flows pouring *over* the scarp of the fault, but south of the Anakies (*sup. cit.* Figs. 7, 8d) the fault displacing the lava-plains basalts. He refers to a post-Newer Basalt movement and it is apparent from his Figs. 7, 8d, that this occurred after the Werribee Plains lava-field, but it is apparent, too, that it was before The Island scoria-cone flow poured over the scarp near Rowsley. The Pleistocene movement on the fault is newer than Middle Pleistocene and The Island lava possibly late Pleistocene but probably Postglacial.

The erosion of the marginal valleys of The Island—the Werribee to a depth of 615 feet and Myrniong Creek to 430 feet, has been taken as evidence of their great age as well as that of the infilling basalt. That this is not necessarily so, is apparent when

one considers the Bullengarook lava-residual, 8 miles to the east, which has many features in common with The Island. There the marginal valleys, Goodman's Creek and Coimadai Creek, have been cut to a depth of over 400 feet below the original surface of the Bullengarook scoria-cone flow. The limestone at Coimadai was deposited in one of the marginal valleys and according to Coulson (1924) was chemically precipitated in a small lake just before, during, and after the eruption from Mt. Bullengarook. The lake was probably formed by the damming of a lava flow (Keble, 1945). Its recent age is indicated by the occurrence of the remains of *Nototherium* in it.

There is the possibility that the Myrniong implements were buried in a cache, a common practice among the aborigines, particularly with stone axes; in view of the fact that more than one implement was found, this seems improbable. A doubt, too, has been expressed by a few archæologists that they are implements at all, but they have been accepted by most.

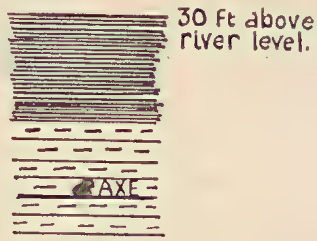

FIG. 8.
Section in the hole at Bushfield.

If The Island basaltic lavas belonged to the lava-plains phase the age of the implements would be over 200,000 years! Their occurrence under a scoria-cone flow makes them probably early Postglacial and no older than any of the more ancient implements found in Victoria. They presumably belong to one of Hale and Tindale's earlier industries, perhaps the Tartangan.

The Bushfield Axe was found by E. W. Hamilton, of Warrnambool while he was sinking a hole to a depth of 8 feet on the right bank of the Merri River to anchor a power-winch to clear the bank of the river of trees. The site of the hole was about a quarter of a mile north of Bushfield, on Allotment I, Parish of Meerai.

Mr. S. R. Mitchell examined and checked with me the section in the hole shown in Fig. 8, in which tuff rested on tuffaceous limestone in which the axe was found.

The tuffaceous limestone is a lacustrine deposit which, when it was formed in the lake, incorporated the tuff falling at the time.

Miss J. Hope Macpherson, conchologist to the National Museum, has identified the land shells found in it as *Ameria acutispira* Tyron and *Lymnaea brazieri* Smith, forms found in slow moving water or a marsh.

The hole was put down in an accumulation (Fig. 9, YDZ) of stratified tuff and tuffaceous limestone on a river-terrace, C (Fig. 9) that was formerly covered by 5 feet of stratified tuff, now removed by slip-erosion. The axe was found at a depth of 3 feet 9 inches, but its original depth, when the uppermost stratified layers, D (Fig. 9) covered it, was about 9 feet.

It was not possible to obtain a single section giving all the features in evidence. Fig. 9 is a composite section.

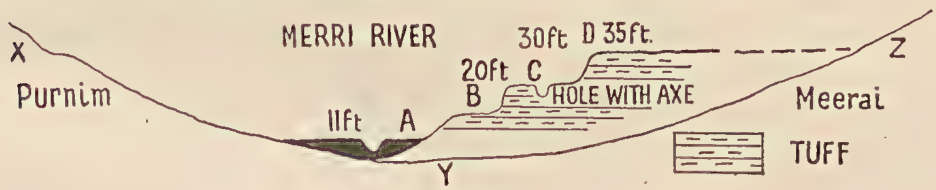

FIG. 9.

Composite section across Merri River in the direction of a fence-line on the left bank bearing N. 53° E.

The succession of events may be summarized as follows:

The valley XYZ was cut in Tertiary limestone, probably during the last glacial period, and was periodically covered during the Postglacial by tuff from Tower Hill, 7 miles to the west, until the tuff reached the level XDZ. While the valley XYZ was being infilled, the Merri River continued to flow, although it was from time to time impeded by the accumulating ash when lacustrine or marsh conditions prevailed. It ultimately cut the channel XYD along the eastern contact of the tuff with the Tertiary limestone to a depth of 40 feet below the surface layer XDZ. In this channel, the flood-plain A, about 150 feet wide, formed and has since been entrenched to a depth of from 15 to 16 feet by the vertical erosion following the last lowering of sea-level. The surface of the flood-plain was at the time of inspection 11 feet above the level of the water in the Merri River, which was 4 or 5 feet deep; the bed of the River opposite the hole in which the axe was found is about 30 feet above the level of low water at Warrnambool Bay. The time taken for the accumulation of the 9 feet of tuff covering the axe together with that taken for the valley XYD to reach maturity is the age of the axe. The flood-plain A was formed at or about the Postglacial Optimum, probably just before the rising sea-level of the Postglacial reached its maximum, and after Tower Hill had ceased to be active: the vertical erosion of the Merri

River preceding its formation was contemporaneous with the concluding stages of the Tower Hill activity. It is therefore apparent that the axe is more than 4,000 years old, and allowing for the maturing of the valley XYD, its age is perhaps 6,000 years. The appearance of the sides of the hole sunk for the power winch exclude the possibility of its having been from the surface in a cache.

The axe (Pl. 2, Fig. 7) was of basalt and not complete. It has a cutting-edge that may have been polished but now shows no sign of it, and a hafting-groove towards the head, most of which is missing. It shows slight signs of patination but there was not adherent matter; possibly the ash-matrix was not adherent. Before it was covered with the uppermost layers of tuff (D. Fig 9) it was, doubtless, lying on the surface exposed to the elements.

Mulder (1904) states that the meaning of native names for our volcanoes indicates smoking, hot, ground such as Koroit [Tower Hill] "suggesting that the natives saw the volcanoes when in action, but at a period so remote that even the tradition had died out, the names only surviving." This has been questioned but legends—some have been already given—relating to volcanic activity have been recorded from so many of the tribes who lived on the lava-plains and among the scoria-cones of western Victoria, that there seems to be a germ of truth in them. That the aborigines could visualize volcanic activity without some of them having seen it, is inconceivable.

Mr. Morgan, the owner of the property on which the axe was found, stated that he found an axe in the tuffaceous limestone where it is exposed on the side of the valley XYD with limy material adhering to it; he threw it into the river.

The period when the Bushfield Axe was used is contemporaneous with one of Hale and Tindale's middle industries, but precise correlation is impossible.

Summarizing the evidence of the artefacts found at Tartanga and Devon Downs in South Australia, and those associated with dunes and the volcanics of Victoria, such points to a Recent or Postglacial age for them. In view of this, discussion here mostly concerns climatic change during the Postglacial.

IV. Bones Shaped by Man or Animals

It must be conceded that Spencer and Walcott (1911) make out a case for cuts on the bones of marsupials having been made by the carnassial of *Thylacoleo.* In this they follow in the wake of De Vis, whom they freely quote; he had long recognized the work of

the teeth of that animal and was pre-eminently fitted to judge which cuts on the Buninyong Bone could be ascribed to it, and which to human agency. His discussion (De Vis, 1899) on the shaping of the bone is pertinent to a general discussion of the shaping of bone artefacts and is given here at some length.

De Vis's figures 1 and 2 are reproduced here as Fig. 8, Pl. 2.

. . . . At first sight the fossil appears to have been intentionally shaped to adapt it to some instrumental use. It may, then, be convenient to confirm the first impression by pointing out the marks of human workmanship which it has, with more loss [*sic*] certainty, preserved to us. It consists of part of the distal half of a right rib, the seventh or eighth, of an animal so large that it could only have been one of the greater *Nototheres,* in all probability *Nototherium mitchelli* Owen. It is perfectly mineralized in the usual manner, differing in no wise in texture and colour from the well preserved contemporary fossils found elsewhere. . . The length of the fragment is 154mm.; by the loss of its central edge, which has been split off, its greatest breadth has been reduced to 42mm. On its posterior aspect (Fig. I), there is at (a) an obvious flattening of the upper part of the blade, the surface of the bone for a length of 65mm. having been removed to an appreciable depth, and apparently by some mode of abrasion; near the distal end of the split edge on the same side appears a marked hollow (b), at the bottom of which the cancellous structure of the interior of the shaft has been by the like means brought into view.

So far the abnormal features observable are not of intrinsic importance. They may have been the result of ordinary physical agencies of attrition. A similar explanation of the condition of the lower end of the bone, or at least of one edge of it, is, on the contrary, inadmissible. On its posterior face (Fig. II) the rib has here been half sundered by a cut through its dense cortex (c) effected by strokes of a sharp instrument. A little lower down on its opposite face (Figs. I and IId), it has been divided to a large extent, and the part beyond the two nicks so made has broken off, the line of fracture naturally occurring between them. The extreme edge of the fracture was brought to coincide with the inner edge of the lower nick and this consequently presents a fairly sharp edge, rendered somewhat jagged by adherent remains of the internal cancelli. The surface of the lower nick (Fig. Id) is convex in both its directions of extent, but whether this rounding off is the result of an original method of formation by filing, scraping or shearing tool, or by the subsequent grinding of a surface in whatever way produced, is not to be gathered from the existing surface. In the latter case it is of course quite possible that this bevelled surface also might have been the outcome of mere physical action of a piece of rib lying in a watercourse or sand drift with one end partially exposed; it is even possible that the severance of the bone on this side of it was due to such cause. But these conjectures seem to be entirely forbidden by the complete absence of any sign of abrasion on the inner surface of the edge of the nick; the broken walls of the bone cells, even at its extreme edge, are as sharp and prominent as they were left by their fracture, and we are therefore driven to the conclusion that this surface, however formed, was intentionally formed. That the surface of the upper nick—that on the opposite side of the bone (Fig. IIc)—could not have been yielded by any physical process, is on the other hand unquestionable. It is certainly the work of an animal possessed of a chopping instrument, and as far as we know the only animal of the age of the *Nototherium* that can excite even a passing suspicion is the so-called Marsupial Lion, *Thylacoleo carnifex* Owen, a confirmed

bone-eater, with enormous shearing teeth. With the ossifragous capability of *Thylacoleo* we are not at this day unfamiliar, and experience makes it quite safe to say that the bone was not cut by the molars of that animal.

Powerful as its jaws undoubtedly were, they have left no evidence that they were able to cut through dense bone to any considerable depth, certainly not to a depth of 3mm., as in the case before us. They chopped the surface (generally on opposite sides) but slightly, to a depth of a millimetre or so at the most, and by the impact of the blow or by continued effort crushed the bone in twain. The form of the incision is in itself sufficient proof that it was not the work of *Thylacoleo*. Its outer or upper edge, crossing the rib obliquely, is irregularly undulating, its surface inclined, from without inward to an open angle, shows under a certain incidence of light, three shallow, unequal undulations, or rather subconchoidal depressions which could have been sculptured by an instrument having a strong bevel above its cutting edge. The surface of wear of the molars of *Thylacoleo*, which so frequently leaves its impression on the substance of long bones subjected to their action, is level, except that occasionally it is more or less distinctly bevelled off at its posterior end; the cut effected by it across the shaft of a bone is therefore a straight-edged and flat-surfaced notch. Of producing one with an edge which is even slightly scalloped and with a broad oblique surface of conchoidal facets, it is altogether incapable. We have, therefore, to fall back on an unknown user of an instrument adequate to the purpose, and this could not well have been any other than man. If now we are prepared to accept the view that this bone was wrought by human hands, and for the nonce assume the genuineness of the fossil, we shall have little difficulty in understanding how and why it received its shape. We may infer that the upper nick was first made; afterwards, and probably with the same instrument —a small, sharp stone tomahawk—the lower nick; the bone then broken between them, and the lower end ground with a bevel to obtain an edge which should be curved, moderately sharp, and rather rugose.

The Buninyong Bone is in the collection of the National Museum, Melbourne, and was available to Spencer and Walcott, who were members of the staff of that institution. They (1914 *circa*) sum up their conclusion in the following remarks:

The more carefully and the longer we have examined the specimen especially in the light of bones, the cuts and marks on which we feel convinced have been made by a predatory animal, the more certain we feel that the only remaining alternative—human agency—must be invoked to account for the origin of some of the characters exhibited on the specimen.

This conclusion was arrived at after they had made an exhaustive study of all kinds of cuts on marsupial bones. In a contribution (Spencer and Walcott, 1911) giving the results of their research, they deal mainly with bone fragments obtained at Pejark Marsh by A. J. Merry with the millstone found by him, and other bone fragments obtained there by themselves; they also discuss fragments from Buchan and Lake Colongulac in Victoria, some from South Australia, and others from New South Wales. In regard to the Pejark Marsh fragments they say:

We were at first, more especially perhaps as the aboriginal implement was of the nature of an anvil or pounding-stone, disposed to attribute to a human

agency the fragmentary condition of the bones forwarded by Mr. Merry; but further consideration and the securing of a larger collection have caused us to modify this opinion. We also thought that the place where the bones and implement were found was probably once a camp by the side of a lagoon or marsh, but our investigations on the spot led us seriously to doubt this original surmise. In the first place the bones in the patches disclosed were not accompanied by the concomitants of an aboriginal camp, and, more important still, many of the fragments obtained showed unmistakable evidence of the fact that some powerful predatory animal had been at work on them.

The cuts on the bones described by them differ in shape and length. In shape the shallow surface incisions vary from straight to slightly curved. They give the impression in many examples that the whole surface of the bone was scratched by a sharp-edged or pointed implement. There are, also, infrequent deeper cuts or gashes, V- or wedge-shaped in cross-section, some of which have been made at such an angle that they have removed a sliver of bone from its surface. Most of these they ascribe to the Dingo, the Thylacine, or *Sarcophilus*.

In the Pejark Marsh fragments, the cut most characteristic is a clean one, sloping slightly, in some specimens from 5 to 7mm. wide. In other specimens it is not single but multiple, directed to give the bone a pointed end, as, too, does a diagonal cut. The characteristic cut results in a shallow concavity similar to, according to them, that made by the carnassial of *Thylacoleo,* and it is their opinion that most of these cuts have been made by that marsupial. They describe, however, a bone with two cavities, on each side of the bone, one slightly in advance of the other. The curves of these cavities are much smaller than in the other specimens; one particularly seems as if it had been formed by several blows or applications of some instrument, by which small pieces were broken out, leaving a somewhat jagged edge. From the deepest part of the concavity towards the pointed end of the specimen, the thin outside layer of the bone has been removed and its margin is similarly defined by scallops. The shape of the pointed end, they state, is due to cuts.

They quote De Vis's statement as to the bone-cutting powers of *Thylacoleo* and instances where he shows bones exhibiting marks and impressions of its molars. After examining the Pejark bones they were convinced that they were cut by *Thylacoleo* which had evidently greater power in this respect than is attributed to it by De Vis.

Most of the *Diprotodon* bones obtained by S. R. Mitchell and myself from the Pejark Marsh bone bed exhibit the shallow surface incisions and a few gashes; only one—portion of the diastema—showed a clean, straight cut through bone about 5mm.

thick (Plate 2, Fig. 11). Another piece (Plate 2, Fig. 10) of a lower incisor, 120mm. long, with a longer diameter of 45mm. and a shorter one of 33mm. exhibits on its outer surface fine incisions and a gash or two. A lower incisor, broken across, shows at one end a fairly smooth, wind-polished cross-section, and at the other end, a very irregular one. The smooth section is due to a break made soon after the death of the Diptrotodon, for it shows numerous, shallow incisions made by the teeth of some small predatory animal when the incisor was green. The irregular cross-section at the other end is due to a break that occurred some time after death, and seemingly before the tooth was buried by deposition. The smaller diameter of the incisor is 1·25 in. and it was too massive for any animal to bite through. It is difficult to account for either of the breaks unless they were the work of man. That he was in the district at the time is shown by the occurrence of the Pejark Marsh Millstone in a bed below the bone bed.

Spencer and Walcott came to the conclusion in regard to the Buchan Bone that "in the absence of definite proof, that man was [not] at any time an occupant of the cave in which the Buchan Bone was found, and the cuts were made by *Thylacoleo.*"

The bone fragments from Salt Creek, Normanville, South Australia, showed mostly straight, blunt gashes, a few the characteristic curve of the cuts of the Pejark Marsh bone fragments, but no example of the clean cuts right through the bones as at Pejark Marsh. They concluded that here too, all the cuts could have been made by *Thylacoleo.*

The cuts on the Myall Creek fragments from New South Wales are ascribed by De Vis to *Thylacoleo*; here again the clean cuts right through the bones are absent.

The Colongulac Bone was picked up on the shores of Lake Colongulac, about 10 miles E.N.E. of Pejark Marsh. The cuts (Plate 2, Fig. 9) are quite different in shape to any at Pejark Marsh. Spencer and Walcott state that they were made on the 4th metatarsal probably of the extinct *Palorchestes* and consist of two, deep, wedge-shaped notches extending a little more than half way across the bone. The greatest width of one notch is approximately 12mm. and that of the other about 10mm. Where the two notches are confluent on the margin of the bone, it has been penetrated to a depth of 6mm. The notch in the dorsal surface is, as nearly as can be measured, 10mm. in depth, compared with 6mm, in the case of the ventral one. Spencer and Walcott give the facts concerning the finding of the bone and accept its authenticity. They compare the gashes to one of the Myall Creek fragments

which De Vis, if he examined it, attributed to *Thylacoleo* and state:

> There is admittedly, as regards size, a great difference between the Myall bone and the Colongulac bone, and moreover in the latter instance we have no corroborative evidence of the work of *Thylacoleo* in the presence of markings or cuts of any kind which might safely be attributed to him. At the same time it throws much doubt upon what might otherwise unhesitatingly be accepted as the handiwork of man, more especially when we know that that work is not of a nature practised by the natives of Australia in historical times.

It might be inferred from these comments that they were reluctant to attribute the gashes to other than man. In other words (1914 *circa*) they expressed the same indecision in connection with the Buninyong Bone:

> The acceptance of the authenticity of the work [on the Buninyong Bone] as that of prehistoric man including the cuts on the under side of the bone must discount very seriously the objections we have made to the possible human origin of the cuts on the Pejark and Colongulac bones on account of Australian man not being known to cut bones in such a manner, in which respect he must then have differed from his predecessors. Thus the deciphering of what is man's work and what is the work of beast becomes purely a question of deciding the work has been performed for a definite and useful purpose by an intelligent being or in the haphazard manner of a bone-eating animal.

There is little doubt that the Colongulac Bone came from a swamp deposit, in the author's opinion, one probably contemporaneous with the bone bed of Pejark Marsh which is above that from which the Millstone came; this being so, there is indirect evidence of man existing in the Lake Colongulac area when the Colongulac bone was fashioned. Its uniqueness and the fact that it may be man-made is sufficient justification for including it here with bones affording some evidence of antiquity. That the bone itself is ancient is shown by the fact that it is a metatarsal of the extinct *Palorchestes*.

Perhaps the most striking fact in this review of bone fragments shaped by man or cut by aninmals is that the clean cuts through the bones bearing so great a resemblance to the work of man are characteristic of Pejark Marsh and are not found on bones elsewhere, except perhaps, at Buchan. While there is no doubt that many of the incisions on the Pejark Marsh fragments have been made by animals, the fact that man lived in the district when they were made, suggests the possibility that some of them were made by him. With the illustrations of characteristic Victorian fragments (Plate 2, Fig. 2), others of bone implements from the Suffolk Bone Bed of Pliocene age illustrated by Moir (1932) are given to show the resemblance.

V. Palaeogeography of the Postglacial and Last Glacial Periods.

The Proto-Indics or Australoids by whatever routes they came to Australia had to pass over some deep channels and no eustatic lowering of sea-level in the last 50,000 years has been nearly sufficient to expose the floors of them. During the Postglacial, the last glacial stage (Wurm 3) and the antecedent interglacial, there has not been a landbridge connecting Australia with Asia or with the islands to the north except New Guinea. One existed at some earlier geological period long before the earliest evidence obtained by the writer of the presence of man in Australia. That the Proto-Indics in their migration southwards had recourse to sea-travel, was realized by Elliot Smith (1930) who pointed out that they had to cross Wallace's Line between Borneo and Celebes. In these notes on the palæogeography of the regions north of Australia, it will be seen that they had to pass over much wider extents of water. The distribution of land and sea during the Postglacial and at the close of the last glacial periods are discussed together with the climatic changes that are known to have occurred during those stages—changes that had a profound bearing on habitation and migration.

During the last glacial stage, Daly (1934) estimates a lowering of sea-level of about 294 feet. The northern strand line of Australia and the south-west strandline of New Guinea were then continuous; New Guinea was joined to Australia by a more or less extensive coastal plain (Fig. 10). This extended in places more than 150 miles north of the existing coastline of Australia, and on the south-western side of New Guinea some 350 miles, including what are now the Aru Islands; it extended as far east as Long. 145° which passes through the Gulf of Papua, east of Cape York. At its northern extremity, it was nearest Suli Mangoli, the easternmost of the Sula Islands of the Celebes Group, and in the west to Timor.

There are peoples in Sumatra, Borneo, and Celebes with a Proto-Indic background. These three islands were joinel during the 294 feet lowering of sea level except at the Strait of Macassar (Fig. 10) which, at its narrowest, was about 30 miles wide. To migrate to a region further south, the route, even if it were partly by land, was also necessarily by sea, requiring the use of some kind of sea-travel. There are certain probable routes leading to the point opposite and nearest to Australia, the shortest distance across the deep channels, routes that brought would-be migrants with their primitive means of transport within possible crossing-distance. These are the Celebes—New Guinea route, the Timor

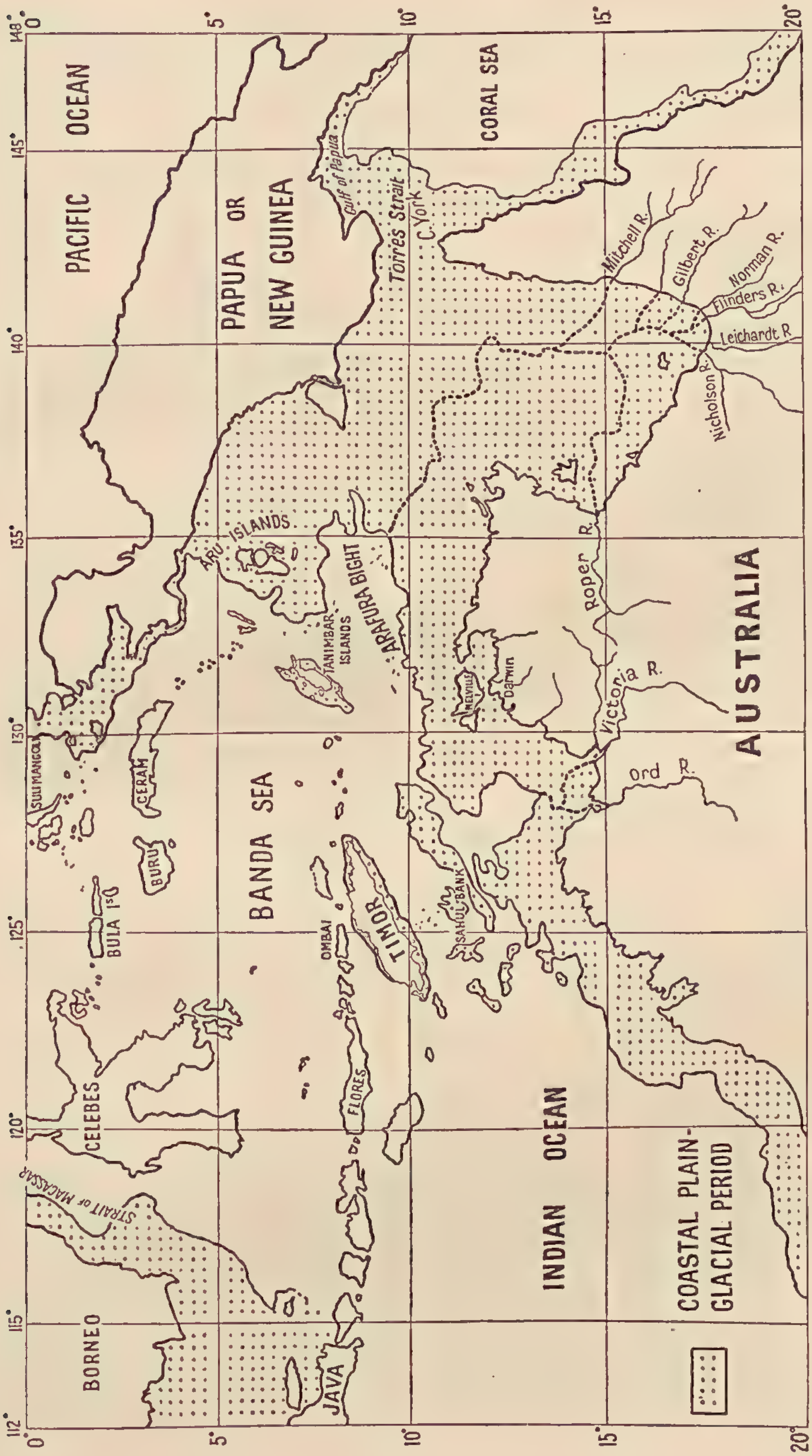

FIG. 10.
Coastal Plain of Glacial Period.

route, and the Timor-Tinamba route (Fig. 10). The least amount of sea-travel mileage necessary to cross the channels together with their depths is

Route	Least number of travel-miles			Depth in feet.
	Glacial Period	Rain-forest reached C. York	Mid-Postglacial	
Celebes-New Guinea	176	176	176	3,000
Timor	60	180	188	2,000
Timor-Tinamba	288	300	300	1,500

Soundings on the Admiralty Chart on the whole are too far apart for detailed bathymetrical contouring, but they plainly indicate three coastal plains in the profile (Fig. 12) of the continental shelf. The lowest shows up at 276 feet below existing sea-level, and, allowing for the recent 15-20 feet lowering of sea-level, is undoubtedly the surface of the coastal plain of the last glacial period. The high pinnacles in Fig. 11 are presumably due to

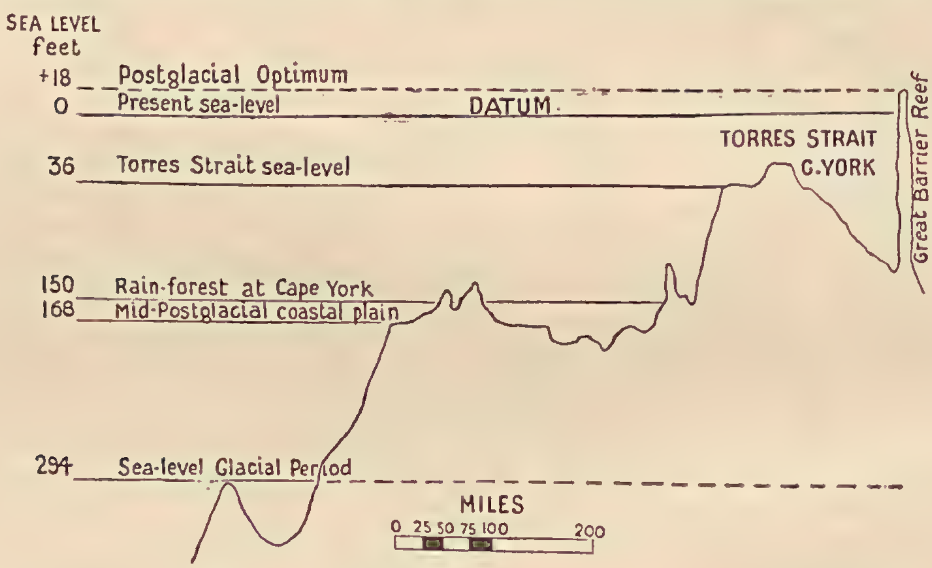

FIG. 11.

Section of sea-floor from outlet of Flinders River in Glacial Period through Torres Strait.

coral growths. That it was a land-surface formed by eustatic adjustment is suggested by the following indirect evidence. It will be noted (Fig. 10) that, during the last glacial period, the outlets of the Victoria and Ord Rivers of the western river system emptied into a landlocked bay across the opening of which lay an island. The floor of this bay was 174 feet below the mean level of the coastal plain during the glacial period, now about 264 feet below existing sea-level. Ascertained by soundings, this floor

is mainly mud and sand but one sounding bottomed at a depth of 396 feet below existing sea-level, or 132 feet below the mean level of the glacial coastal plain, on "dead coral." The living range of coral is 120 feet, so that, taking this extreme range, sea-level when the coral was alive was 276 feet lower than it is now, an estimate, excluding adjustments for tectonic movement, that

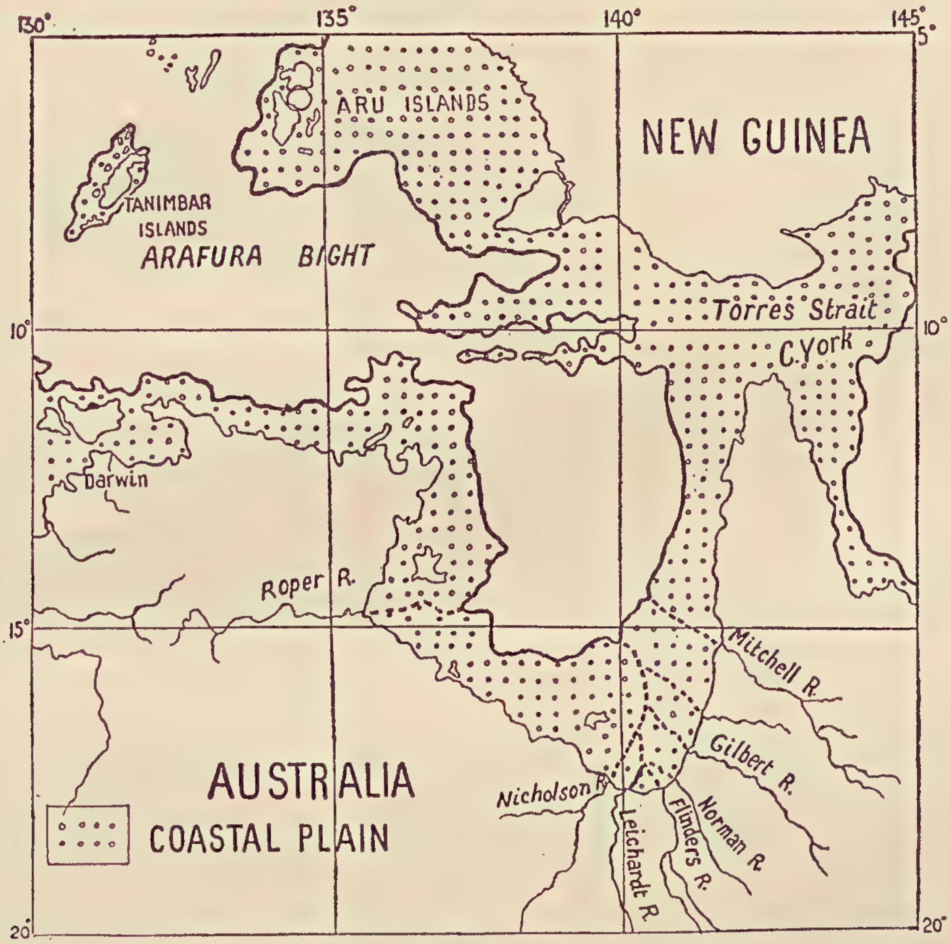

FIG. 12.
Mid-Postglacial Coastal Plain.

agrees fairly well with Daly's figure of 294 feet: if the coral lived on the bottom at a depth of 102 feet, there is complete agreement.

During the last glacial period, the Flinders, the trunk-stream of the mature eastern river-system of which the Roper, Nicholson, Leichhardt, Norman, Mitchell and other streams were part, crossed the coastal plain and emptied into the lowered sea-level of the Arafura Bight (Figs. 10 and 12). This system is a Pleistocene one and the trunk-stream had to adjust itself to the lowered sea-

level of the last glacial stage; from its outlet into the Arafura Bight, there was probably a gorge some distance upstream cutting back into the mature erosion of the Pleistocene cycle, but the soundings are not close enough to show this. There was obviously in this region some tectonic movement, presumably subsidence, but its nature and extent are not known. There is evidence of another coastal plain at about 168 feet (Fig. 11) referred to here as the Mid-Postglacial coastal plain, and a more recent one in Torres Strait—the Torres coastal plain—at 54 feet (Fig. 11); but its surface is generally masked by coral-growths.

During the glacial period, the lower part of the basin of the Flinders River was, for the most part, in the arid belt but in the Mid-Postglacial period it was in the savannah (Fig. 13) with the tropical rain-forest on the north about to encroach on its eastern side. In the Mid-Postglacial period, the Flinders emptied into a landlocked bay, an evolutionary stage of the Gulf, about 150 miles north of its present outlet. This bay was about 340 miles long, subcircular at its southern extremity, but widening to a width of over 200 miles at its northern end. Its waters covered the basin of the drowned Flinders River of the glacial period, and the bay had a narrow entrance from the Arafura Bight through the drowned gorge. Immigrants, if they came by sea-travel, passed up the channel and crossed the bay to its southernmost extremity until they came to the outlet of the Flinders.

In the glacial period much of the Northern Territory was in the arid belt, as, too, was the Cape York Peninsula south of Point Duyfhen. The northern part of the Peninsula was in the savannah, also Tanimbar Islands, Aru Islands, and the coastal plain for 50 miles north of the present shoreline of Melville Island. The tropical rain-belt, extended north of a line approximately coincident with the W.N.W. political interior boundary of Papua. The line of maximum aridity—the middle of the arid belt—was a few miles south of the present outlet of the Flinders River into the Gulf of Carpentaria and trended W.N.W. to near the southern extremity of Cambridge Gulf in northern Western Australia. The arid belt itself reached about 350 miles further south to the steppe-region and east to the rainfall-reliability belt which reached as far north as the Atherton Plateau. The Flinders and some of its tributaries carried off the rainfall of the latter, and although the lower reaches of the trunk-stream flowed through the arid belt, it was, nevertheless, a river of some volume. When, however, it and its tributaries flowed over the Mid-Postglacial plain, it was not the full-flowing stream of the glacial period, for its headwaters were not in the rainfall-reliability belt

which had moved southwards over 300 miles. It then drained mainly seasonal coastal rain.

The distribution of the climatic belts when the tropical rain-forest reached Australia is shown in Fig. 13.

VI. Probable Landing Places.

In the light of the palæogeography, the much discussed problem of the time of the arrival of the Proto-Indics or Australoids in Australia acquires a different setting to that presented by some anthropologists. It cannot be answered without taking into account the changing coastline and climate of the latest Quaternary periods, and the realization that some kind of sea-transport was necessary to cross deep channels.

Elliot Smith (1930) gives the ethnic relationship of the Australian:

> The aboriginal Australian belongs to a race that is sometimes called Pre-Dravidian, a term intended to emphasize the fact that certain jungle tribes of Southern India, the Kadir of the Anaimalai Hills, the Paniyan of Malabar, the Wynad and Nilgiris, the Irula and the Karumba of the Nilgiris, scattered among the Dravidian peoples, conform to the same physical type, and obviously belong to the same race. Before we attempt to discuss the antiquity of the population of Australia it is clearly important to remember this most westerly relic of the same people. The Vedda of Ceylon, the Sakai of the Malay Peninsula and East Sumatra, the Toala of Celebes, and possibly some other people of Borneo, provide evidence in corroboration of the fact of the migration of the Australian race.

The northern limit of the Australian Region being the northern extremity of New Guinea before Torres Strait was formed, the time of the arrival of the Proto-Indic in those parts must be regarded as his first appearance in any part of Australia. No attempt is made here to fix the time of this; it belongs to the distant past and the early migrations of man. The time of the first appearance of the Australoids in Australia in its present form is the immediate purpose. Having landed in what is now New Guinea, the routes taken by the migrants are conjectural, but they were presumably through the western half of that island; they could have moved partly by sea or along the highlands, or across the now submerged coastal plain. The only part of the coastal plain extant outside Australian waters is, seemingly, Aru Islands, now occupied by a Melanesian people of mixed strain. Keesing (1946) comments suggestively:

> Persons [of the Papuan type] . . . appear to show a considerable strain of the same racial materials as the nearby Australian Aborigine—the so-called Australoid features—combined with the dark Negroid elements uppermost in the region. It might be expected on the ground of geography, they are found

most frequently in the western and southern parts of New Guinea, nearest Australia. This strain also occurs here and there in the interior of the larger islands farther to the east, and in New Caledonia at the east end of the main chain.

Contrasting the accepted Melanesian type, he states that it is

concentrated more along the coasts of the larger islands, including the north and east of New Guinea, and in the small islands east of Fiji. Much the same physical characters are often found farther west in those parts of the Molucca-Timor regions and of east Flores not settled by the Malayan peoples.

In submitting that the Proto-Indics came as a jungle-people with the tropical rain-forest, the movements of the climatic belts and incidentally their movements are timed here from the peak for Wurm 3 in the curve for solar radiation (Zeuner, 1945) viz. 25,000 years ago. Zeuner gives (*op. cit.*) for comparison the estimates of others for this figure—De Geer 18,000 years, Heim 16,000 years, Steck 20,000 years and from 14,000 to 15,000 years, Penck and Brückner 24,000 years. Based on the 25,000 years of the solar radiation curve, the writer estimates that the tropical rain-forest reached Cape York, the northernmost point of Australia in its present configuration about 15,000 years ago, but it must be proportionately less if we accept the other estimates, viz.:

De Geer	Heim	Steck	Penck and Bruckner
11,000	10,000	12,000 and 8,500 to 9,500	14,000

Assuming a progressive Postglacial rise of sea-level since Wurm 3, the coastal plain of the glacial period was submerged about 24,000 years ago, the Mid-Postglacial plain about 16,000 years ago and the 54 feet coastal plain to form Torres Strait about 8,000 years ago. These estimates are necessarily approximate for it is known that there were, in glaciated regions, fluctuations in the recession of the ice-sheet during the general retreat of the ice that are possibly reflected in the movements of sea-level.

That portion of New Guinea nearest Suli Mangoli has always been in the tropical rain-forest, and immigrants from Celebes to New Guinea passed from one part of the forest to another. In the west, if the 60 mile channel separating Timor from Australia was crossed by a hypothetical people during the glacial period, the crossing was from one arid region to another. Conditions were more inviting when the rain-forest reached contiguous points on Timor and the mainland about 11,000 years ago, but the strait had then widened to about 150 miles.

A good deal of interest attaches to the means of transport as the most primitive craft known are recorded from north-west Australia. Pitt-Rivers (1906) traces back the development of sea-going craft to the pointing of the ends of a solid tree-trunk—the first stage of the dug-out canoe. He cites Gregory who relates that when his ship was off the north-west coast of Australia in 1861, it was visited by two natives who came on logs about 7 feet long and a foot thick shaped like canoes, not hollowed out, but very buoyant, which they propelled with their hands only, their legs resting on a little rail made of small sticks driven in on each side. Pitt-Rivers corroborates Gregory's statement with a description of such craft from another source. He also mentions the dug-outs used by the aborigines on the shore of south-eastern Australia near Cape Howe seen by Captain Cook in 1770. The dug-out reached Britain before the Neolithic industry. Childe (1929) mentions that deep-sea ships sailed between the Indus and the Euphrates over 6,000 years ago. No certain representations of these are known, but some depicted on a Babylonian vase suggest that they evolved from river craft.

VII. Critical Millennia.

Elkin (1938) commenting on the arrival and migrations of the aborigines states:

> They landed in northern Australia, probably on Cape York Peninsula and perhaps also at different times on other parts of the coast. From there they gradually spread across the continent, though we cannot speak with certainty about the routes followed. They probably spread around the north and down the east and west coasts; down the Queensland rivers on to the Diamantina and Cooper and so into South Australia; from the Queensland coast on to the headwaters of the Barwon and along the Darling River system and on to the Murray right to its mouth; and gradually across the deserts from north to south until the Bight was reached.

These are, for the most part, the routes suggested by the vicissitudes of the Postglacial climate.

Although the tropical rain-forest reached the Cape York Peninsula (Fig. 13) approximately 15,000 years ago, its advancing edge was probably not sharply defined and it was preceded by forest country merging into savannah; this the jungle-people penetrated. "Desert and dense forest are the extremes," says Marett, "between them—anywhere in fact between open steppe and park-land, lies the happy mean, not only for the hunters but likewise for the food-raising peoples." But the Proto-Indics were essen-

tially a jungle-people and in no sense a food-raising people. How far habitable conditions for such existed on the so-called savannah south of the fringe of the tropical rain-forest is problematical. If we could determine it with certainty, we might say with more precision when they appeared on the Australian mainland. The northern half of the savannah to which these habitable

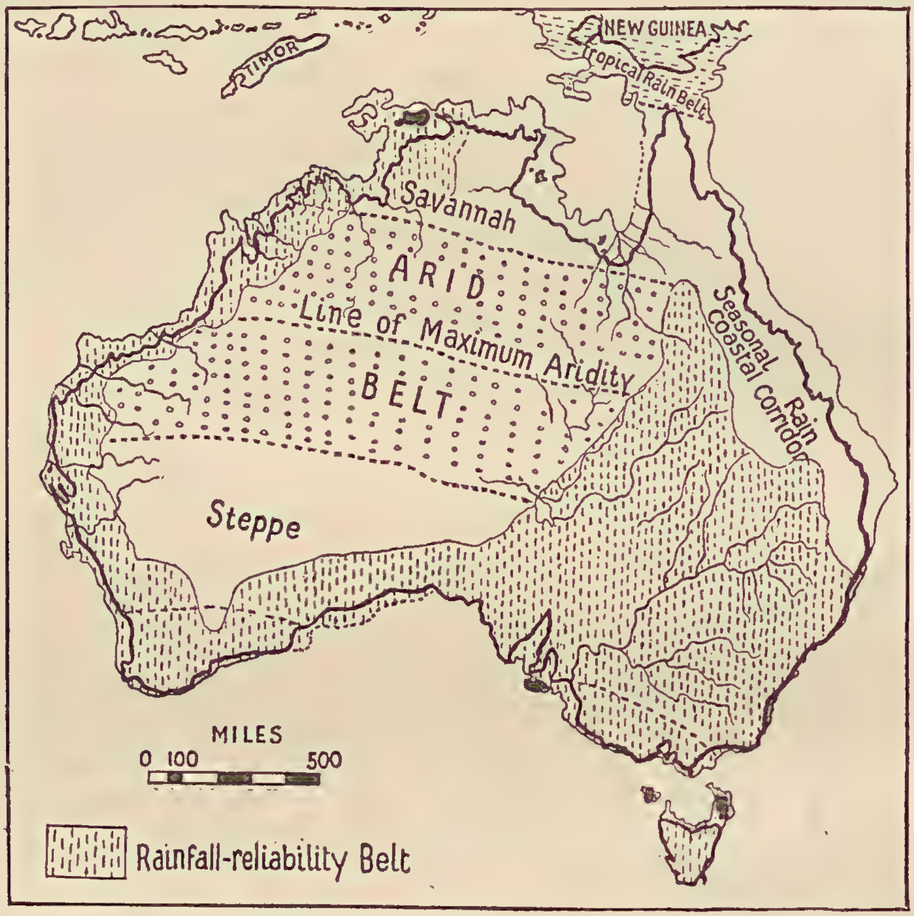

FIG. 13.
Climatic Belts and Rain-reliability Belt when the Tropical rain-forest reached Cape York.

conditions were seemingly confined, reached the Cape York Peninsula about 21,000 years ago. An estimate based on these considerations is that the Australoids came between 15,000 and 18,000 years ago, at a time when the savannah was habitable and before it showed signs of the approaching aridity. That the Australoid could acclimatize himself to arid conditions is evident from his subsequent history; that he did not at first choose an arid environment is obvious.

When Torres Strait was formed, he was completely cut off

from communication by land with other races. It is probable that during the 7,000 years between his first appearance and his isolation, there were at least three waves of migrants.

Those who used the western route either came by the littoral as migrants from the east or as immigrants by some kind of craft. Although the shortest distance from Timor to the mainland was the most likely route taken, other routes were possible. As contiguous sides of the strait separating Timor from the mainland were both in the tropical rain-belt for the first time in the Postglacial period 11,000 years ago, it seems likely that immigration by this route started then. There are no records of Proto-Indics east of Java in the Sumatra-Timor chain of islands; this is peopled by Malays and Melanesians. It may be found that the Proto-Indics were there 11,000 years ago, but their suspected absence makes the spread of the tropical rain-forest to Timor and the mainland less significant.

The following tabulation gives the years previous to the present time when geographical, climatic, and environmental conditions existed.

Years.	Geographical, climatic and environmental conditions.
2,000	End of period of extreme aridity.
4,000	Postglacial Optimum. Arid belt reaches southernmost limit.
6,000	Beginning of period of extreme aridity in southern Australia.
8,000	End of pluvial period in southern Australia. Torres Strait formed; Australia isolated from New Guinea.
11,000	Rain-forest reached both sides of Timor Strait.
15,000	Tropical rain-forest reached Cape York Peninsula.
16,000	Mid-Postglacial coastal plain.
18,000	Probable first appearance of Australoids in Australia.
24,000	Beginning of submergence of the glacial coastal plain.

As stated (*supra* p. 70), these figures are based on the radiation curve and a maximum estimate for Wurm 3, but if Steck's minimum estimate for this be taken at 9,000 years, the appearance of the Australoids in Australia in its present form was less than 6,500 years ago, and the other figures correspondingly less.

VIII. Migration Routes in Australia

As Cape York Peninsula as part of the old land-bridge that joined New Guinea to Australia was the first and main place of entry for the Proto-Indics, the degree of habitability in the past of the tracts leading from it suggests the favoured routes for migration on the mainland. The availability of food and water was the assurance that intending migrants sought, and this was regulated by the movements of the climatic belts and with them the rainfall-reliability belt. As pointed out, the latter moved furthermost north in the glacial period and widened to its maxi-

mum, while during the greater part of the Postglacial, it slowly moved southwards and contracted to its minimum at the Postglacial Optimum. The fertility of eastern Australia has been influenced by the fact that the Great Dividing Range skirts its eastern coastline and is responsible for the coastal corridor and the orographic rainfall belt; on the other hand, the fertility of the coastal belt of western Australia has been complicated by conditions not found in the east.

In connection with migration, climatic conditions are discussed 25,000 years ago during the glacial period; 15,000 years ago or thereabouts when the tropical rain-forest advanced into the Cape York Peninsula; 8,000 years ago when Torres Strait separated New Guinea from the mainland, and 4,000 years ago at the Postglacial Optimum. The fertile tracts at these times are best considered by grouping the rivers into basins in respect to the sources, intake, and outlets of the drainage channels of the contracting rainfall-reliability belt and the advance southwards of the arid belt. This grouping is tabulated.

Basins	Rivers	Source	Outlet	Rainfall
I Carpentaria (western part)	Roper, McArthur, Gregory, Leichhardt, Cloncurry.	Selwyn Highlands	Gulf of Carpentaria.	Tropical
II Carpentaria (eastern part)	Mitchell, Gilbert, Flinders.	Great Dividing Range	Gulf of Carpentaria.	Tropical orographic, monsoonal.
III Diamantina	Diamantina, Georgina, Hay.	Selwyn Highlands, Macdonnell Ranges	Lake Eyre	Tropical
IV Cooper	Cooper, Thomson, Barcoo.	Great Dividing Range	Lake Eyre	Tropical orographic
V Darling	Darling, Barwon, Paroo, Warrego, Condamine, Macintyre, Gwydir, Namoi, Castlereagh, Macquarie, Bogan.	Great Dividing Range	Murray River	Orographic
VI Murray	Murray, Lachlan, Murrumbidgee, Goulburn.	Great Dividing Range	Southern Ocean	Orographic

In the glacial period, the rainfall-reliability belt extended on the west side of the Main Coast Range as far north as the Atherton Plateau, and west from the Great Dividing Range beyond Lake Eyre covering most of the Diamantina Basin (III) and the Cooper Basin (IV); west of it to the western coastal belt. Central Australia and a large part of Western Australia was in the arid belt and steppe region. The whole of south-eastern Australia,

south of the latitude of Grafton, was covered by it including the drainage systems of the Darling (V) and the Murray (VI).

About 15,000 years ago, when the tropical rain-forest reached Cape York, the rainfall-reliability belt had somewhat contracted. It then extended as far north as Georgetown in Queensland, and as far west as Lake Eyre, covering the eastern half of the Diamantina Basin (III) and the whole of the Cooper Basin (IV); the rest of its cover was much the same as in the glacial period.

Approximately 8,000 years ago, when Torres Strait was formed, the climate was as it is now. The line of maximum aridity (Fig. 1) passed from a little south of N.W. Cape in Western Australia, about 50 miles north of Lake Eyre, to near Walgett in New South Wales. Theoretically, the coincident line of the northern front of the arid belt passed through Boulia in Queensland and its southern front was covered by the westward extension of the belt of rainfall-reliability. North of the arid belt was savannah and south of it steppe. The rivers of the Diamantina Basin (III) had their sources in the savannah and outlets into Lake Eyre in the arid belt; the Cooper Basin (IV) was wholly in the arid belt.

At the Postglacial Optimum, 4,000 years ago, the northern peak of the rainfall-reliability belt had receded south to about the latitude of Maryborough in Queensland; the line of maximum aridity then passed approximately through Marree south of Lake Eyre, the northern front of the arid belt through Alice Springs, and its southern front was covered by the rainfall-reliability belt. The headwaters of the Darling—the upper reaches of the Condamine and some of its southern tributaries, were during the Postglacial Optimum within the rainfall-reliability belt. The rest of its valley (V), almost to its confluence with the Murray, was in the arid belt which began to encroach on it about 5,000 years ago. The take-off or orographic rainfall in the Darling Basin has been, during this period, small; it has been estimated that now, 4,000 years after the Postglacial Optimum, due mainly to evaporation, less than 2 per cent of the rain falling in the upper Darling valley passes the town of Bourke on its middle reaches. The headwaters of the rivers of the Diamantina and Cooper basins were in the savannah, but their middle and lower reaches in the arid belt. It has been already pointed out that since the early part of the Postglacial, the rivers of the Diamantina Basin (III) have not been channels for orographic rainfall, and their drainage has been, for the most part, the scanty tropical rainfall of the sub-tropics.

From the climatic standpoint, the problem of migration along the west coast of Australia is a difficult one. In Fig. 13 delimiting

the climatic belts when the tropical rain-forest reached Cape York, a belt of coastal rainfall is shown extending up the coast of Western Australia as far north as Cambridge Gulf. This is based on the assumptions that the average path of the lows was considerably north then to where it is now, (Fig. 3) orographical rainfall was intercepted by the Great Plateau of Western Australia of an average height of from 1,000 to 1,500 feet, and this rainfall belt extended north across the western end of the arid belt. Several considerations arise, however, to confuse this simple solution; these include the converse effect to that of the east coast of the prevailing winds in the north-west blowing from the interior of the continent instead of from the ocean, the prevalence of deserts on the west coasts of the continents, and the presence offshore of the branch of the Southern Ocean Current. That there has been a wetter climate in this region is established by ample evidence. Quite recently, Teichert (1946) added to this by noting the presence on Houtman's Abrolhos, 50 miles west of Geraldton, of a rat, a variety of a species now only found on the south coast and southern islands of Western Australia, also a wallaby, a variety of one whose distribution does not now extend much further north than Perth. As representatives of the original stock are now restricted to latitudes considerably south of the Abrolhos Islands, he infers that there has been emergence and a change in climate—a rise in the temperature of about 5°F.

It is evident from this review of former climatic conditions, Australia north of the Murray and west of the Great Dividing Range, or precisely west of the rainfall-reliability belt, has passed through periods of fertility and aridity. Regions that were formerly well-watered and fertile have, with the march of the climatic belts, become deserts, and desert areas have become fertile. The river valleys have been singled out because food and water available along their banks during periods of fertility made them attractive to migrants. This may be inferred from a statement by Elkin (1938):

> The area of the tribal territory varies, for the most part, with the nature of the country, more especially according to its fertility and food supply. Thus, on the north coast of New South Wales a narrow strip of country, roughly 300 miles long by sixty to ninety miles in width but well watered by rivers and a good rainfall, there were several tribes on each river, numbering altogether about twelve with several sub-tribes, whereas in the drier interior of the State the Wiraduri alone occupied more territory than all these tribes put together. Likewise, along the Queensland coast, the country along the Daly, Fitzmaurice and Victoria rivers of the Northern Territory, and in the upper Murray region in Victoria and New South Wales, the tribal areas were comparatively small, whereas the Aranda of Central Australia occupied a large tract of country stretching from about Hermannsburg eastwards well beyond Alice Springs and

south-east right down the whole course of the River Finke for a distance of 400 miles.

And again, in discussing the improbability of the aborigines being only long enough in Australia to increase to their number when the white man came, he states:

> . . . . we know that in many tribes even in good country, a balance between numbers and food resources is maintained by infanticide and sometimes by abortion. In times of severe drought in the drier parts of the continent, infanticide is apt to be practised temporarily in the interests of the adults without any thought of the future of the group.

These quotations indicate how dependent the aborigines were on the fertility of a region and its implied food resources but that, even with fertility in their Australian environment, a balance between numbers and the food available had to be maintained. For a former tropical rain-forest people to favour the arid belt for habitation is unthinkable; their first contact with it would be a deterrent. As Marett (1938) says:

> More especially inhospitable is the arid type of desert, more so even than the frozen type of tundra; lack of rain being the physical scourge that man has to fear most. Nay, as a cause of migration on a grand scale desiccation is perhaps more effective than any cultural influence . . .

Taylor's estimate (1927) of the aridity in northern Australia during the Pleistocene Ice Ages applies also to the arid belts during the Postglacial period:

> We may picture much more repellent conditions in the north during the Pleistocene Ice Ages than obtain today. These may well have prevented any higher race from following the aborigines into Australia.

From the standpoint of subsistence, the fertile tracts with their relative sufficiency of food and water, were the first to be occupied. These were, 15,000 years ago when the tropical rain-forest reached Australia, the coastal corridor and the rainfall-reliability belt which covered the south-east, a narrow avenue at the head of the Great Australian Bight, south-west Australia, and the western coastal corridor. It also extended at this time as far west as Lake Eyre and a triangle (Fig. 13) converging from the head of the Bight on the west, and Grafton on the east, subtended at the north by Georgetown in Queensland.

This triangle embraced part of the Lake Eyre basin, western New South Wales, and a large part of inland Queensland. From the aspect of climate and fertility, it may be assumed that it formerly enclosed an area carrying a relatively large population of aborigines in small tribal areas, but now, as it is wholly within the arid belt, it is sparsely peopled and the tribal areas are large such as Elkin mentions in referring to the Aranda. Some of its

former inhabitants have migrated to more hospitable regions but the remnant has deteriorated with the increasing aridity.

On the other hand, that part of northern Australia now within the tropical rain-belt was formerly in the arid belt. It is estimated that the arid belt left the Carpentaria Basin (I and II) about 9,000 years ago and the lower reaches of the Daly, Fitzmaurice, and Victoria Rivers have been in the tropical rain-belt for 11,000 years. Doubtless, on the lower parts of these rivers, the population has grown with their increasing fertility, brought about by the march of the climatic belts.

On the principle that the fertile tracts were the first occupied this deterioration and amelioration of climate suggests that those which have relapsed from fertility into aridity may well contain remnants of the first-comers to the mainland, while those that have passed from aridity into a condition of fertility, are peopled by later migrants.

The aborigines did not wage war for territorial aggrandizement (Elkin, 1938); their habitat was forced on them by the urge for food and water, not by an aggressor.

IX. Digest of Conclusions.

The main submission in these notes is that the Australoids were a jungle-people who entered Australia before New Guinea was separated from it, in their natural environment—the tropical rain-forest, or a short time before, when forest began to cover what is now the Cape York Peninsula. In the last 150,000 years there has not been a land-bridge connecting Australia with Asia and the Proto-Indics had to cross deep channels whether they came by the Celebes-New Guinea route or the Timor route. The time when these geographical, climatic and environmental conditions existed was between 15,000 and 21,000 years ago, in the early Recent or Postglacial period; the time of their entry is estimated at about 18,000 years ago; this figure is based on the maximum assumption of 25,000 years for the last glacial stage, but if one accepts Steck's minimum estimate for this, it was as recent as 6,500 years ago. It is highly probable that they entered by the Mid-Postglacial coastal plain (p. 67). It is thought some of the aborigines of the north-west and west migrated from eastern Australia, but others may have entered by the Timor route (p. *ante*) in the last 11,000 years.

In the east, migration southwards was along the coastal corridor and the orographic rainfall-belt to fertile south-eastern Australia. With the march of the climatic belts and the contraction of the rainfall-reliability belt, regions that were formerly well-watered

and fertile have become desert, and desert areas have become fertile. This deterioration and amelioration in the climate suggests that regions that have relapsed from fertility into aridity may well contain remnants of the first-comers to the mainland, and those that have passed from aridity into a condition of fertility may be peopled by later migrations. The coastal corridor, orographic rainfall-belt, and south-east Australia have always been more or less fertile, and in these areas we should find the earlier migrants.

Evidence of antiquity from the south-east—Victoria and South Australia—points to a Postglacial age for the appearance of the aborigine. The following are the estimated ages of some artefacts, comprising Neolithic, Mesolithic, and Palaeolithic types, found in the south-east: Altona, 3,000 years; Colongulac Bone, 3,000 years; Pejark Marsh Millstone, 3,000 years; Bushfield Axe, 6,000 years. The age of the Buninyong Bone and Maryborough Axe, the Myrniong implements, and the earliest industry of Tartanga cannot be given in years but they are believed to belong to the lower half of the Postglacial or Recent.

If the first wave of migrants came just before the tropical rain-forest, say 18,000 years ago, they passed over a land-bridge that 8,000 years ago became the floor of Torres Strait. During the intervening 10,000 years, other waves of migrants, no doubt, entered Australia by this land-route, but the Australoids have been cut off from contact with other ethnic types, except by sea, since Torres Strait was formed.

It has been stated that they were originally a jungle-people. This is inferred from communities elsewhere, the Proto-Indics of southern India—the Kadir, the Irulas, the Vedans (identical with the Veddahs) and others who live in the forest on its produce and the wild animal-life in it. The Veddahs of Ceylon and the communities in Sumatra, Borneo, Celebes, the Malay Peninsula, and Siam differed little in their pristine state from the southern Indian Proto-Indics; they, too, were essentially jungle-peoples. They came to Australia as such and, doubtless, remained so until they were compelled to migrate to the savannah and the steppe; when these relapsed into aridity with the march of the climatic belts, those who could not pass on remained to become a "broken people, battered vessels seeking harbour where they could."

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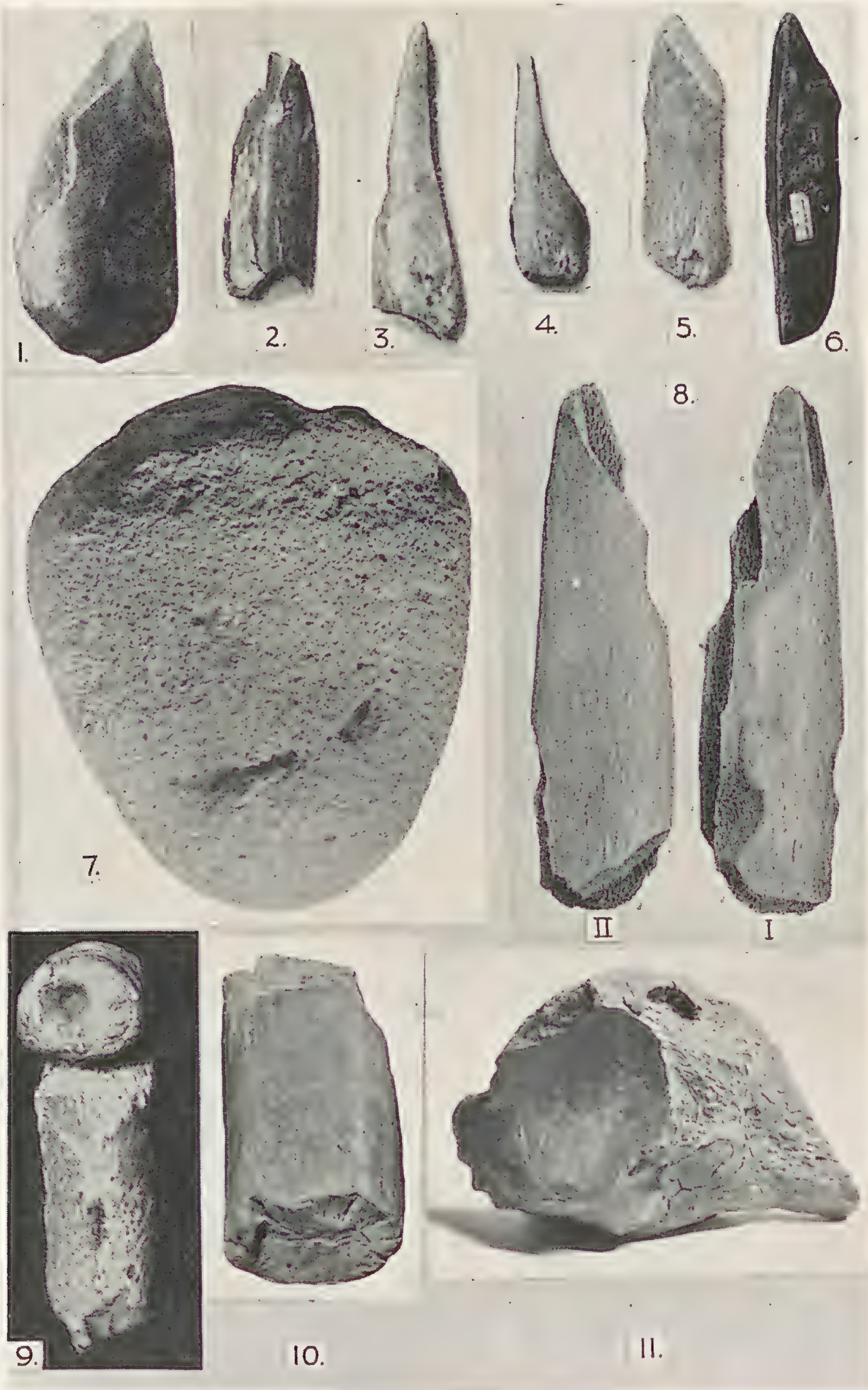
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EXPLANATION OF PLATE.

Plate 2.

Fig. 1. Suffolk, England. Pliocene bone implement from beneath the Red Crag, illustrated by Moir (1932).

Fig. 2. Pejark Marsh, Victoria. Fragment of a limb bone, with one of its corners sliced off by an oblique curved cut. About natural size. From Spencer and Walcott (1911).

Fig. 3. Pejark Marsh. Concave and convex fractures, producing a pointed fragment. According to Spencer and Walcott (1911) the convex fracture is due to the entry of pointed teeth penetrating the bone, both from above and below; the concave fracture may have originated from an incision in the broad end of the bone. Nearly natural size. From Spencer and Walcott (1911).

Fig. 4. Pejark Marsh. Piece of limb-bone with curved cuts attributed by Spencer and Walcott (1911) to *Thylacoleo.* About natural size.

Fig. 5. Pejark Marsh. Oblique cuts believed by Spencer and Walcott (1911) to be similar to those cut with the upper pre-molar of Thylacoleo. About natural size.

Fig. 6. Suffolk, England. Pliocene bone implement from beneath the Red Crag, illustrated by Moir (1932).

Fig. 7. Bushfield Axe, from Bushfield near Warrnambool, Victoria. Two-thirds natural size.

Fig. 8. Buninyong Bone from Buninyong, Victoria. From De Vis (1900). About two-thirds natural size.

Fig. 9. Colongulac Bone from Colongulac, Victoria. Side view, showing the confluence of the two notches. From Spencer and Walcott (1911). About natural size.

Fig. 10. Pejark Marsh. Lower incisor of *Diprotodon* obtained in bone bed below tuff. About two-thirds natural size.

Fig. 11. Pejark Marsh. Portion of the diastema of *Diptrodon* showing a straight cut; the concavity is the socket of the lower incisor. About natural size.

A NEW SALTICID SPIDER FROM VICTORIA

By R. A. Dunn

Fig. I.

(Received for publication June 6, 1947)

This paper deals with a new spider belonging to the genus *Saitis* Simon. Although world-wide in distribution, it is, according to Simon, "en Australie que le genre possède—les plus belles espèces," and certainly the present species does not lose by comparison with the previously described forms.

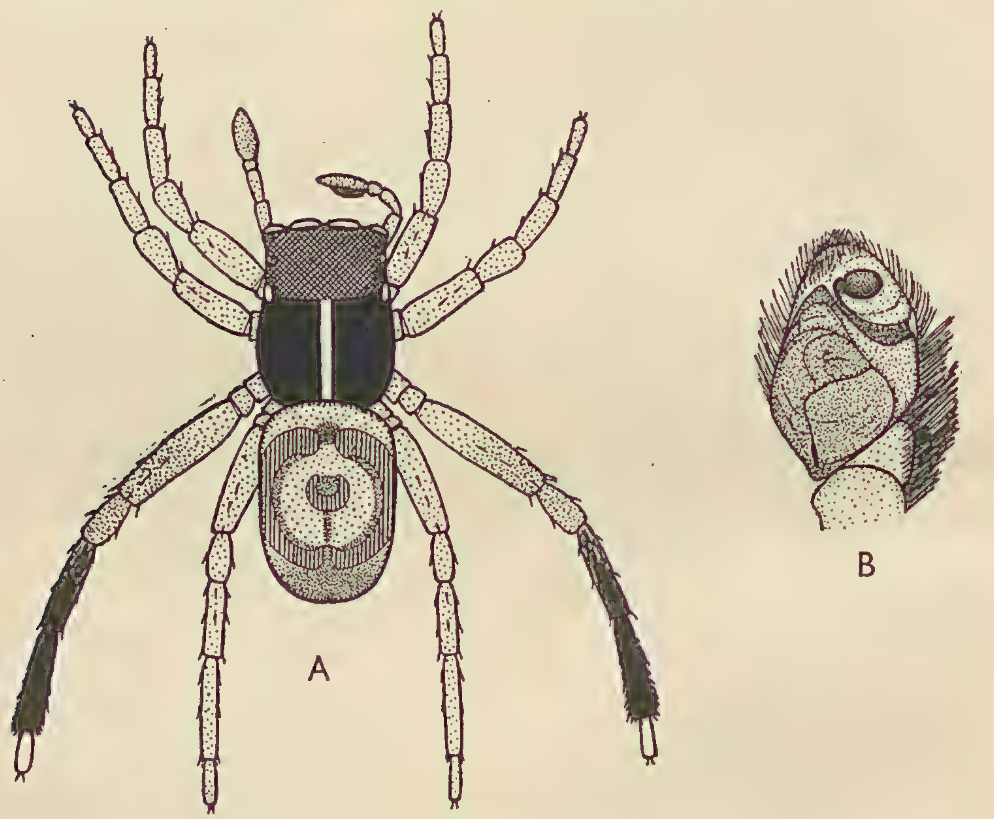

FIG. 1

A. *Saitis pavonis* sp. nov., ♂.
B. Ventral view of right palpus.

Notwithstanding a superficial resemblance to *S. splendens* (Rainbow), it is more closely related to *S. speciosus* (O. P. Cambridge). A key to the males of the Australian species of *Saitis* is given, followed by the description of *S. pavonis* sp. nov.

Family SALTICIDAE
Division UNIDENTATI.
Subfamily Plexippinae.
Genus SAITIS Simon, 1876.

SYNOPSIS OF MALES OF AUSTRALIAN SPECIES.

1. Leg iii longer than leg iv. 2.
– Leg iii shorter than, or only equally as long as leg iv. 7.
2. Abdomen clothed with squamose hairs, with distinct pattern. 3.
– Abdomen clothed with silky hairs, without distinct pattern. *S. lacustris* Hickman.
3. Lateral margins of dorsal epidermis, when folded, covering the ventral surface of the abdomen, where they overlap. 4.
– Lateral margins of dorsal epidermis extending only slightly, not covering the ventral surface of the abdomen. 6.
4. Abdomen, from above, square and angular. Cephalothorax black. *S. vespertilis* Simon.
– Abdomen, from above, long and parallel. 5.
5. Cephalothorax black. Caput with alternative longitudinal bands of greyish-green and scarlet. *S. volans* (O. P. Cambridge).
– Cephalothorax steel-blue. Caput with curved transverse bar of scarlet. *S. splendens* (Rainbow).
6. Lateral margins of dorsal epidermis with a rather dense fringe of long silky hairs. *S. speciosus* (O. P. Cambridge).
– Lateral margins without such fringe. *S. pavonis* sp. nov.
7. Legs 1, 4, 3, 2; leg i being much the longest. *S. pallida* (Keyserling).
– Leg i equally as long as, or only slightly longer than legs iii and iv. 8.
8. Tibia iii and iv with one dorsal spine. Legs 1=4=3, 2. *S. piscula* (L. Koch).
– Tibia iii and iv without dorsal spines. Legs 1, 4=3, 2. *S. nigriceps* (Keyserling).

SAITIS PAVONIS sp. nov.

Male.

	mm.
Total Length	4·34
Length of Cephalothorax	2·12
Width of Cephalothorax	1·52
Length of Abdomen	2·33
Width of Abdomen	1·53

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
Leg i	0·91	0·58	0·58	0·50	0·35	2·92
ii	0·91	0·58	0·58	0·50	0·35	2·92
iii	1·55	0·62	1·03	1·02	0·43	4·65
iv	1·25	0·52	0·72	1·05	0·43	3·97
Palp	0·49	0·32	0·15	—	0·55	1·51

Carapace black, thoracic part with a dark brown median longitudinal stripe clothed with white hairs, cephalic part densely covered with brown squamose hairs, clypeus fringed with long white hairs. Anterior eyes greenish opalescent,

Chelicerœ and maxillœ yellowish-brown. Labium and sternum brown. Coxœ yellowish. Legs i, ii, and iv, yellowish, irregularly marked with brown, clothed with yellowish hairs and fine black bristles, femoræ somewhat lighter in colour. Leg iii with femur and patella yellowish-brown, tibia and metatarsus brown, clothed with reddish-brown hairs and black bristles, except for the base of the femur, which has yellowish hairs; black spatulate hairs are present ventrally on patella and apex of femur, ventrally and dorsally on tibia and metatarsus, being much denser and extending over the lateral surfaces of the metatarsus; tarsus yellow, clothed with long white hairs which are particularly thick and fringe-like dorsally. Palpi yellowish, clothed with yellowish hairs; tarsus brownish-yellow; patella, tibia, and apex of femur densely clothed dorsally and prolaterally with long white hairs. Abdomen with scarlet squamose hairs forming a crescent-shaped figure at the centre of the dorsal epidermis, surrounded by a circular band broken anteriorly and, in most cases, posteriorly; except along the inside edge and at the anterior and posterior divisions of this band, in the concavity of the crescent, and along a median longitudinal stripe from the rear of the crescent, where the bluish metallic hue of the epidermis can be seen, yellowish-white squamose hairs are present, but on the lateral margins they become less dense towards the rear; at the posterior extremity the epidermis is of a greenish metallic hue; a few long black hairs are scattered over the surface. Ventrally, the abdomen is yellowish-brown, mottled with black, and covered with short white hairs. Spinnerets brown.

Carapace high, convex, truncate in front, rear margin rounded and with an almost semicircular concavity, cephalic part fairly flat and sloping forward from near the P.L.E., thoracic part sloping more strongly towards the rear. Clypeus sloping backwards, equal to approximately 13/24 of the diameter of A.M.E.

Eyes arranged in three rows, the front row recurved with the apices in a straight line. Ratio of eyes A.M.E. : A.L.E. : P.M.E. : P.L.E. = 24 : 15 : 5 : 14. The A.M.E. are separated from each other by 5/24, and from A.L.E. by 6/24 of their diameter. The P.M.E. are separated from A.L.E. by 15/24, and from P.L.E. by 13/24 of the diameter of A.M.E. The P.L.E. are separated from each other by 78/24 of the diameter of A.M.E. The ocular quadrangle is broader than long in the ratio 56 : 37, and slightly broader in rear than in front in the ratio 56 : 55.

Chelicerae conical, placed well behind clypeus. Lateral condyles wanting. Promargin of furrow with a single double-pointed and deeply-notched tooth; retromargin with a single large cone-shaped tooth.

Maxillae slightly converging, with scopulæ. *Labium* somewhat triangular in shape, almost as long as broad, apex provided with a group of moderately long bristles.

Sternum oval, convex, broadly truncate in front, longer than broad in the ratio of approximately 4 : 3. Fourth coxæ close together.

Legs 3, 4, 1 = 2. Trichobothria in two rows on tibiæ, in one row on metatarsi and tarsi. Tarsi with claw-tufts and two claws, each claw with about five teeth which increase in length distally. *Palpi* short, with a long, curved, pointed apophysis at the retrolateral apex of tibia. Palpal bulb has the form shown in Fig. B.

Spines on legs arranged as follows. First leg—Femur: dorsal 1.1.1, prolateral 1, elsewhere 0. Patella : prolateral 1, elsewhere 0. Tibia : prolateral 1.1, ventral 2.2, elsewhere 0. Metatarsus : prolateral 1.1, ventral 2.2, elsewhere 0. *Second leg*—as in leg i. *Third leg*—Femur: dorsal 1.1.1., prolateral 1.2, retrolateral 1, ventral 0. Patella: prolateral 1, retrolateral 1, elsewhere 0. Tibia:

dorsal 1.1, prolateral 1.1.1, retrolateral 1.1.1, ventral 1.2. Metatarsus: dorsal 0, prolateral 1.2, retrolateral 1.2, ventral 2.2. *Fourth leg*—Femur: dorsal 1.1.1, elsewhere 0. Patella: prolateral 1, retrolateral 1, elsewhere 0. Tibia: dorsal 1.1, prolateral 1.1.1, retrolateral 1.1.1, ventral 1.2. Metatarsus: dorsal 0, prolateral 1.1.2, retrolateral 1.1.2, ventral 2.2. There are no spines on any of the tarsi, nor on the palpi.

Abdomen somewhat oblong in shape, truncate and concave at the rear; provided with an almost round dorsal epidermis which folds down to cover the sides, reaching to but not covering any portion of the ventral surface. Spinnerets six, situate in the concavity at the end of the abdomen, the anterior pair close together.

Locality: Carnegie, Victoria. Six specimens, all males, collected on October 20, 1946. I have also a specimen collected at Altona on November 5, 1946. A co-type has been lodged with the National Museum, Melbourne; another will be forwarded to Dr. V. V. Hickman, of Tasmania; the remainder being in the author's collection.

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NEW GEOGRAPHICAL RACES OF AUSTRALIAN BUTTERFLIES, WITH A DESCRIPTION OF THE FEMALE, LARVA, AND PUPA OF PSEUDALMENUS CHLORINDA BARRINGTONENSIS Whs.

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Plates 3-8; Figs. 1-5.

(Received for publication October 6, 1947)

Family SATYRIDAE

Xenica klugi mulesi n. subsp.

Male, Above.

Forewing smoky black with orange brown markings, a white pupilled ocellus near apex, dorsum brownish black, a streak of dull black and silvery grey sex scales from vein 4 to vein Ia near its middle. This sex mark is much narrower than in typical *klugi*. Cilia greyish brown.

Hindwing smoky black with orange brown markings, a dull black band in centre crossing lower end of cell, a white pupilled ocellus near tornus, another smaller one in the subapical area.

Beneath:

Forewing similar to upperside, orange brown markings paler, apex pale dull black suffused grey, sex mark absent, ocelli as above, tornus narrowly smoky black.

Hindwing varying shades of greyish brown with darker irregular striæ, central band as above but longer, ocellus near tornus reduced to a minute spot, subapical one smaller and more obscure.

Female, Above:

Forewing smoky black with orange brown markings which are more extensive than in the male, a white pupilled ocellus near apex, sex mark absent, dorsum brownish black, cilia greyish brown.

Hindwing smoky black with orange brown markings, a dull black band in centre crossing lower end of cell, a small white pupilled ocellus near tornus, another in the subapical area which is sometimes reduced to a circular dull black spot, cilia greyish.

Beneath:

Forewing similar to upperside, orange brown markings paler, apex pale brownish black suffused greyish white, in some examples greyish white faintly tinged yellow. Ocellus as above.

Hindwing varying shades of greyish, from ashy grey to greyish brown, with darker irregular striæ which vary in distinctness in individuals. Ocellus near tornus obscure or almost absent, subapical one very faint.

This race is considerably smaller than *X. klugi klugi* Guer. and has been captured only by M. W. Mules at Wardang Island, South Australia. It has not so far been taken on the mainland. The main differences between this race and the typical *klugi* are its smaller size; paler markings on both upper and under sides; the orange brown areas more extensive; the dark markings smoky and not black; and the dorsum dark brownish black. *Xenica klugi* Guer. is a butterfly which is normally found in grassy forested country, usually associated with mountains. It is widely distributed in Australia, ranging from southern Queensland, through New South Wales, Victoria, at Wardang Island S.A., and in south western Australia. It is common also in Tasmania. In Queensland and New South Wales, it is confined to the coastal mountains, but does not actually reach the coast; in eastern Victoria it is found on the mountains further inland as well as on the coast, whilst in western Victoria it has been taken on the Grampians, and at Dimboola and Kiata, as well as nearer the coast. In Western Australia, it frequents the open forest country on coastal areas in the south-west corner of the State.

The occurrence of a subspecies at Wardang Island is certainly remarkable.

A very closely related species, *Xenica minyas* Whs. and Lyell, is common in many places in south western Australia, and it was thought for a time that this species might be the West Australian form of *X. klugi*; both species, however, have since been captured together there. *X. minyas* appears on the wing earlier (October-November) than *klugi* (late October to December), though both occur together later in the season.

Wardang Island is quite unlike any other locality where *X. klugi* has been found. With the exception of very few Casuarinas there are no trees on the island. The principal vegetation consists of saltbushes, native hop, and a species of small bushy and very prickly acacia. Sand dunes run along the western side of the island, and it was in small grassy patches amongst these dunes that Mules captured this subspecies. Its flight season is from late October until December. The total area of Wardang Island is about 5,000 acres.

Specimens of *klugi* from the Grampians are smaller than those from eastern Victoria; apart from size they do not differ very much from eastern examples. From Kiata males only have been seen by the author—these are slightly smaller than the Grampians specimens; the black markings of the upper side are not quite as dark as *klugi,* but the underside is typical. These specimens were

captured in early November in a grassy spot amongst large gum trees on the extreme northern edge of the Little Desert.

For distribution of *X. klugi* and its race see Fig. 1.

Types, male and female, in the collection of M. W. Mules.

Addendum.—During late October and in November, 1947, the writer visited Western Australia, and there made many observations regarding the habits and distribution of *Xenica klugi klugi* Guer. in that State. The closely allied species *Xenica minyas minyas* Whs. and Lyell. occurs in the same localities as *klugi,* but is on the wing a month earlier; a period of overlapping with

Fig. 1. Distribution of *Xenica klugi* Guerin, and its race.
(1). *Xenica klugi klugi* Guerin. Found also in Tasmania.
(2). *Xenica klugi mulesi* n. subsp.

both species takes place, however. Specimens of *klugi* from the west are very similar to those taken in Victoria and New South Wales, and do not in any way compare with the race *mulesi* from Wardang Island, S.A., nor with the small pale examples from Kiata and the Grampians in western Victoria.

It is interesting to note that *klugi* is plentiful on Rottnest Island which is about 8 miles from the mainland, but as far as is known *X. minyas* does not occur there.

Considerable intergrading takes place between the two species; early examples of *X. minyas* are typical, but towards the end of

its season females especially are lighter in colour because of restriction of the black markings. The underside in both sexes is definitely greyer and more like that of *X. klugi.* Much interesting work remains to be done with respect to both species.

Heteronympha cordace wilsoni, n. subsp.

Male, Above:

Forewing black with bright orange brown markings, an ocellus near apex, blue pupilled.

Hindwing black with bright orange brown markings, a larger ocellus near tornus, blue pupilled.

Beneath:

Forewing similar to the upper side, black markings much reduced, outer margin broadly brown, ocellus reduced to a small black spot faintly pupilled bluish.

Hindwing uniformly dull yellow-brown, a central and several irregular markings obscurely brown, ocellus faintly visible from above.

Female. Above:

Forewing as in the male, black markings slightly broader, ocellus larger.

Hindwing as in the male, black markings broader, ocellus larger than in the male.

Beneath:

Similar to the upperside, outer margin broadly brown, ocellus much reduced in size.

Hindwing almost uniformly yellowish grey, a large central and several irregular markings yellowish brown. Two ocelli, the upper one just visible, the lower one much reduced. The two bluish-white spots between the ocelli in typical *cordace,* absent.

This race is slightly smaller than the typical species, and so far is recorded only from Dartmoor in south western Victoria, at least 200 miles west of the nearest locality where *cordace* had previously been taken, i.e., Mt. Macedon.

The first specimens were captured by F. E. Wilson in January, 1940, after whom this new race has been named.

The greatest difference between this race and typical *cordace* is in the underside which is almost devoid of markings, especially in the hindwing; the upperside is much more golden on account of the restriction of black markings. This butterfly is always taken in swampy places, where its foodplant occurs.

There is some doubt whether *Heteronympha cordace* really belongs to the genus *Heteronympha;* until the complete life history has been worked out and studied, this cannot be decided. Dr. Waterhouse and the writer have had eggs and small larvæ only. The egg is almost globular, pale creamy green in colour, and faintly ribbed. The young larva is very pale green with a black head.

All the other species of *Heteronympha* have a well defined sex mark in the forewing of the male—this is absent in *cordace.* The general appearance of the butterfly does not agree with other species of the genus, which fall naturally into two well defined sections, (a) those with dimorphic females (*H. merope* and *H. mirifica*), and (b) the remaining species, which are all very similar, even in the sexes. (*H. banksi, solandri, paradelpha* and *penelope*).

FIG. 2. Distribution of *Heteronympha cordace* Hubn. and its race.
(1). *Heteronympha cordace cordace* Hubn. Found also in Tasmania.
(2). *Heteronympha cordace wilsoni* n. subsp.

Heteronympha cordace has a fairly wide distribution in southern Australia, and occurs also in Tasmania. Specimens from the northern limits of its range where it is essentially a mountain butterfly, are considerably darker than those from Victoria, where it occurs at lower elevations as well as in the mountains.

Tasmanian specimens are more like Victorian ones, with the exception of those from Cradle Mountain, which are decidedly smaller than specimens from any other locality.

For distribution of *H. cordace* and its race see Fig. 2.

Types, male and female, in the collection of the author.

Family HESPERIDAE

Subfamily Trapezitinae

Trapezites sciron eremicola, n. subsp.

Male. Above:

Forewing smoky brown-black, three subapical spots yellow, a larger yellow spot near end of cell and three others, two in discal area and one below cell, the latter very faint. Cilia greyish white.

Hindwing smoky brown-black, a central area palely dusted yellow. Cilia greyish white.

Beneath:

Forewing dull grey-brown, apical and subapical areas greyish, markings similar to upperside, subapical spots obscure.

Hindwing greyish brown, with a series of spots greyish white edged black.

Female. Above:

Forewing smoky brown black, three subapical spots yellow, a large yellow spot near end of cell, and three others, two in discal area and one below cell, yellow; the latter being the largest. All spots larger and brighter than in the male. Cilia greyish white.

Hindwing smoky brown black, a central area palely suffused yellow. Cilia greyish white.

Beneath:

Forewing brown-black suffused greyish along dorsum, apical and subapical area greyish brown. Spots as above but restricted and paler.

Hindwing greyish brown, with a series of spots dull white edged black.

The species *T. sciron sciron* Whs. and Lyell. has been recorded from south-western Australia only, the holotype male coming from the Stirling Ranges. Two very worn specimens of this new sub-species were captured by M. W. Mules and the author at the Little Desert, Victoria, in early November, 1945. Both specimens were in a very wasted condition, and it was decided to visit the locality earlier the following year. This was done in late October, and both males and females obtained in excellent condition. The butterfly is apparently local, because it occurred only on three slight elevations, each about thirty feet above the surrounding country, and all within half a mile of one another. Although a week was spent collecting on the desert, no other spots were found.

Both males and females came to sport on these little ridges, the general habits and mode of flight being comparable to those of *T. luteus* which this subspecies somewhat resembles, especially on the upperside.

A diligent, though fruitless search for larvæ and pupæ was made on all likely foodplants, one in particular greatly resembling the dwarf *Xerotes* on which *Trapezites luteus* Tepper feeds. This plant has been identified as *Lepidosperma carphioides.*

In general appearance *T. sciron eremicola* is darker above than typical *sciron,* and the underside shows much difference and is uniformly much greyer.

It is probable that the life history when determined will resemble that of *T. luteus,* which has a spring and an autumn brood. *T. sciron eremicola* flies with *Motasingha dirphia trimaculata* Tepper, with which species it can easily be confused. Actually the first two

FIG. 3. Distribution of *Trapezites sciron* Whs. and Lyell and its race.
(1). *Trapezites sciron sciron* Whs. and Lyell.
(2). *Trapezites sciron eremicola,* n. subsp.

specimens taken by Mules and myself were at first thought to be small males of *trimaculata,* but when examined, the absence of a sex mark in the male at once separated them.

The Little Desert is situated approximately six miles south of Kiata, and extends east and west for some twenty miles. It is quite likely that *T. sciron eremicola* will be found on the Ninety Mile Desert which is situated a few miles north west of Little Desert. The vegetation and type of country in both places are very similar. A butterfly which has extended its range over such great distances must surely occur at places between Western Australia and western Victoria; no doubt when more collecting has been done in the intervening country, this butterfly will be found.

For distribution of *T. sciron* and its race see Fig. 3.

Types, male and female, in the collection in the National Museum of Victoria.

Family LYCAENIDAE

Subfamily Ogyrinae

Ogyris amaryllis hopensis n. subsp.

Male. Above:

Forewing shining metallic blue with very narrow black outer margins. Cilia grey.

Hindwing shining metallic blue with very narrow black outer margins, broader at tornus. Cilia grey.

Beneath:

Forewing smoky black, broadly grey at apex narrowing to tornus, crossed with darker markings. Cell crossed by greyish white bars edged with metallic blue.

Hindwing dark blackish suffused grey and lightly tinged brown, crossed by interrupted darker markings, brown-black.

Female. Above:

Forewing shining metallic blue, in some examples slightly silvery blue, margins narrow, black, interrupted with grey. In some specimens a narrow black bar at end of cell, in many absent altogether.

Hindwing shining metallic blue, sometimes slightly silvery, margins narrow and black, interrupted with grey, broadest at apex and tornus. Cilia grey.

Beneath:

Forewing similar to the male. Cell dark orange red between second and third greyish white bars.

Hindwing brown-black faintly overlaid with grey, crossed by interrupted darker brown-black markings, those on the central area black.

In typical *amaryllis* there is almost always an orange red spot between the base of the forewing and the first cross bar. The chief characteristics of this race are its darker and more smoky appearance beneath, and the greater expanse of metallic blue on the uppersides of the wings in the female. It was first taken by F. E. Wilson and the author at Mt. Hope, northern Victoria, in the larval and pupal stages. These were found sheltering beneath the bark of black wattle trees on which the foodplant, a greyish leaved mistletoe, (*Phrygilanthus eucalyptifolius*) was growing. There were no ants in attendance.

The other Victorian race, *O. amaryllis meridionalis* Beth. Baker, occurs over much of western and north western Victoria, where the larvæ feed on *Loranthus quandang,* which grows on Casuarina trees. I have many times taken larvæ and pupæ of this race, and have found them attended by no fewer than three species of ants. *O. amaryllis hopensis* appears on the wing during

October and November, and is almost certain to be double brooded, as is the case with the race *meridionalis*.

It is most likely that *hopensis* will also occur on Pyramid Hill which is 10 miles from Mt. Hope in a south-westerly direction. These two localities are very old granite residuals which have been completely surrounded and partly covered with alluvium. Between them, and the undulating Mallee country some thirty miles to the west, lies the flat flood plain of the Loddon, which

Fig. 4. Distribution of *Ogyris amaryllis* Hew. and its races.
(1). *Ogyris amarlyllis amaryllis* Hew.
(2). *Ogyris amaryllis hewitsoni* Whs.
(3). *Ogyris amaryllis meridionalis* Beth. Baker.
(4). *Ogyris amaryllis amata* Whs.
(5). *Ogyris amaryllis catherina.* Whs.
(6). *Ogyris amaryllis hopensis* n. subsp.

extends northwards to the Murray. The vegetation on Pyramid Hill is similar to that on Mt. Hope.

O. amaryllis was described by Hewitson in *Catalogue Lycaenidae Brit. Museum,* 1862, p. 3, and since that time a number of distinct geographical races has been found and described.

The range of this butterfly is remarkable, extending from Cairns, in North Queensland, through that State, New South Wales, Victoria and South Australia to Western Australia. In

Queensland and New South Wales, it occurs along the coast as well as far inland, but is confined to inland districts in Victoria, and to a lesser extent in South and Western Australia.

For distribution of *O. amaryllis* and its races see Fig. 4.

Types, male and female, in the collection of the author.

Subfamily Lycæninae

Candalides heathi doddi n. subsp.

Male. Above:

Forewing dark bronze brown suffused purplish, outer margins brown-black; more broadly so than in *C. heathi heathi*. Cilia grey.

Hindwing dark bronze brown suffused purplish, outer margins brown-black. Cilia white.

Beneath:

Forewing silky white suffused cream, a series of black spots, usually six in number, near the margins, those nearest tornus being the largest.

Hindwing silky white suffused cream, a series of black spots, usually six in number, near the margins, diminishing in size from tornus towards apex.

Female. Above:

Forewing brown faintly tinged bronze, central area purplish, only faintly so in some examples. Outer margins brown-black, cilia white.

Hindwing brown faintly tinged bronze, central area purplish, faintly so in some examples. Outer margins narrow, brown-black, cilia white.

Beneath:

Forewing pale greyish white inclined to be silky, with a series of black spots as in the male.

Hindwing pale greyish white inclined to be silky, a series of six black spots diminishing in size from tornus towards apex.

This race is much larger than the typical *heathi*, or any of its other races, males averaging 30mm. across the expanded wings, and females from 31 to 34mm. Large specimens of male *heathi* on the other hand average 26mm., and females 28mm. across the wings.

C. heathi doddi was first captured by F. J. Dodd after whom it is named, on the headwaters of the Tubrabucca River, (altitude 4,300 feet) on the northern end of the Barrington Tops, New South Wales, in late December 1946. Several days later, the author in company with Dodd, took further specimens on the headwaters of the Manning River, some six miles from the original spot, and on the following day again at the original place.

No doubt this butterfly occurs at other places on the Barrington Tops. The author spent two weeks collecting there on two previous occasions, but did not encounter this butterfly. This may have been due to the fact that on these trips only the southern end of the Tops was visited, near the site of Edward's hut. This is 17 miles from the source of the Tubrabucca River.

The country in which *doddi* was found is very steep and rocky. The butterflies were flying up and down the almost precipitous slopes, and seemed to be attracted to a native species of *Veronica* which was growing there. Though not in flower at the time, these bushes were frequented by the butterflies, but a search on them failed to reveal any eggs or larvæ. There were many other apparently similar gullies within easy distance, but in these *Veronica* was not growing, and no butterflies were seen.

FIG. 5. Distribution of *Candalides heathi* Cox and its races.
(1). *Candalides heathi heathi* Cox.
(2). *Candalides heathi ærata* Montague.
(3). *Candalides heathi alpina* Waterhouse.
(4). *Candalides heathi doddi* n. subsp.

The other mountain race of *C. heathi—alpina* Whs., is much smaller than this race, and can at once be distinguished by the grey-brown underside of both sexes.

Candalides heathi heathi Cox was first described in 1873 from specimens caught at Bridgewater near Adelaide. This species has a wide distribution in southern and eastern Australia, ranging from Blackwater which is 110 miles west from Rockhampton on the Longreach railway, southwards, and round to Geraldton in Western Australia. It has developed several geographical races,

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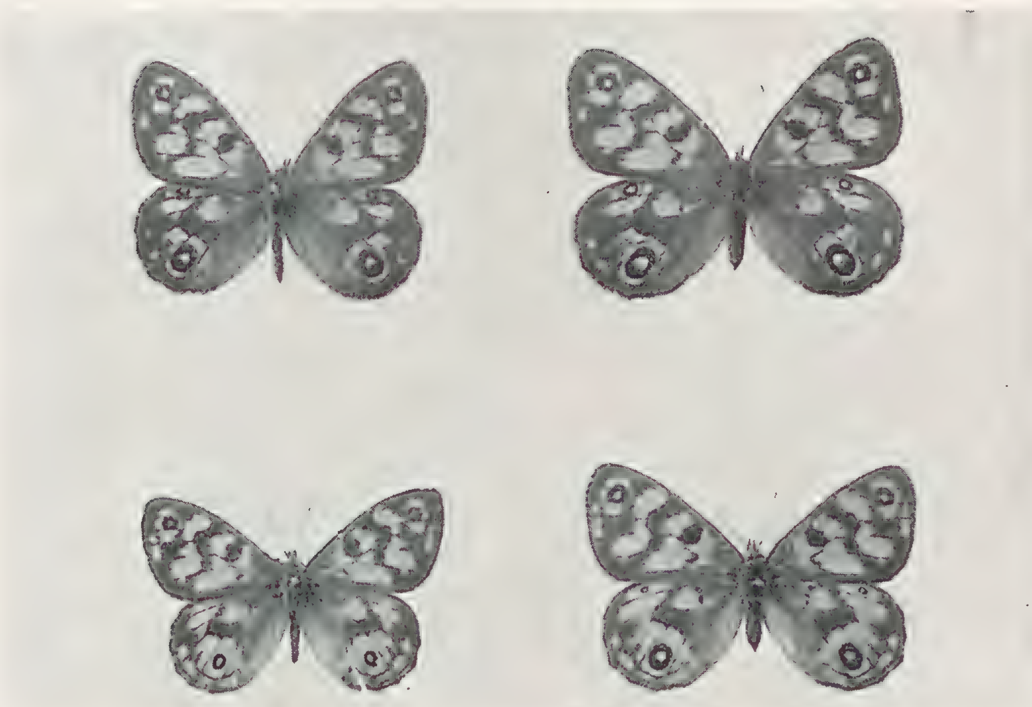

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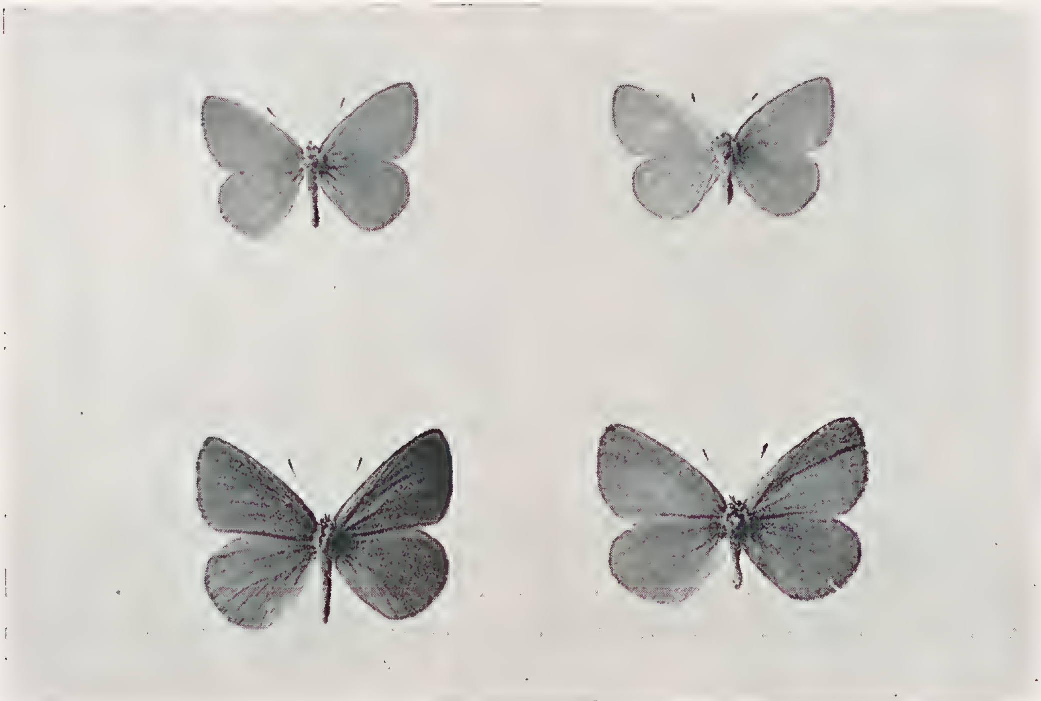

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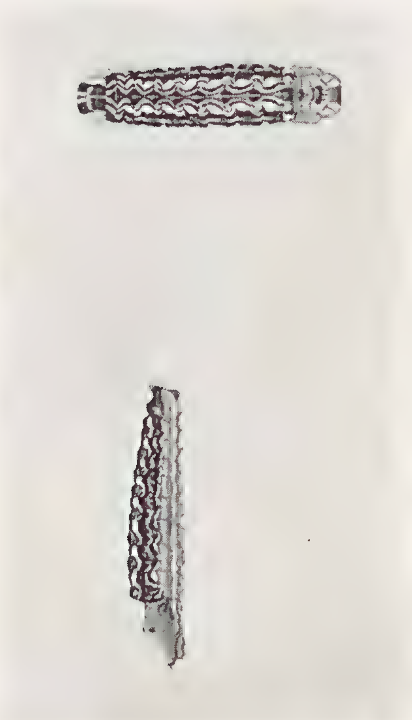

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C. heathi aerata Mont. from Monte Bello Is. and Geraldton, W.A.; *C. heathi alpina* Whs. from Mt. Kosciusko and the high country in the Federal Capital Territory, and *C. heathi doddi* n. subsp. from the Barrington Tops. *C. heathi heathi* Cox is found in south Queensland, near Sydney, sparingly in Victoria, and near Adelaide. It is a very local butterfly in Victoria, being found in the Moe-Trafalgar area, Gippsland, at Mt. Macedon, and at Daytrap in the Mallee. In South Australia it appeared to be confined to the Adelaide region until recently, when a female specimen of *C. heathi* from Holowiliena Station in the Flinders Ranges near Cradock, and 250 miles north of Adelaide was shown to the author by M. W. Mules, who captured this specimen in the ranges on December 26, 1942. The country there is normally very dry, and the vegetation scanty.

Examination of this specimen shows it to approximate to Western Australian examples, which are paler than those from the east. In this specimen, the forewings are dusky brown with the central purple areas extending almost to the tornus, this is so in the hindwings also. The underside is greyish white and not inclined to be silky. The size is slightly larger than typical *heathi*. It will be interesting to see further specimens of this butterfly from this locality. It is much more plentiful in south Western Australia and ranges up as far as Geraldton.

For distribution of *C. heathi* and its races see Fig. 5.

Types, male and female, in the collection of the author.

ACKNOWLEDGMENTS

For generous assistance in the preparation of this paper, the author thanks Mrs. S. Whincup of the National Museum for assistance with the geology of the Mt. Hope area; Mr. L. Chapman, also of the Museum, for assistance with maps; Messrs. F. E. Wilson and M. W. Mules, of Melbourne, for valuable data; Mr. R. E. Trebilcock, of Kerang, for assistance in gathering material, and Mr. F. J. Dodd, of Dorrigo, New South Wales, and Mr. T. Meehan, of Tubrabucca, New South Wales, for help in collecting specimens and transport respectively.

Subfamily **Theclinae**

Notes on the Butterfly, *Pseudalmenus chlorinda barringtonensis* Whs., with a description of the female, larva and pupa.

The genus *Pseudalmenus* Blanchard is represented by one species only, namely *chlorinda chlorinda,* which was described in 1852 from specimens taken in Tasmania. Since that time, geographical races have been described from Victoria (*zephyrus*), and the Blue Mountains, New South Wales (*chloris*) by Waterhouse and Lyell (2). On October 30, 1927, a male specimen of *Pseudalme-*

nus was picked up on the snow near Edward's hut on the Barrington Tops, New South Wales, altitude about 5,000 feet. This specimen differed considerably from any of the other races of the species, and was described by Waterhouse (3) as *Pseudalmenus chlorinda barringtonensis*.

Whilst at Newcastle during December, 1946, the writer visited the northern end of the Barrington Tops, which has been rather neglected from a collecting point of view. On arrival at Tubrabucca on December 26, a chance meeting with another entomologist took place, and this coincidence resulted in the discovery of the life history of this hitherto very little known butterfly; Mr. F. J. Dodd, then of Murrurundi, N.S.W., had anticipated the writer by a day or two, and, on December 27, Dodd remarked that he had seen some Lycaenid larvæ which he thought were those of another well known and widely distributed butterfly, *Ialmenus evagoras evagoras* Don., feeding on a wattle tree, at the same time stating that he thought that they looked slightly different from others he had seen. An examination was immediately made of the larvæ which were about half grown—these were certainly not larvæ of *Ialmenus evagoras,* but they resembled somewhat larvæ of the Victorian race of *Pseudalmenus* (*zephyrus*). Further searching resulted in the finding of fully grown larvæ, and eventually the writer found a pupa under the bark of one of the food trees, this too resembling the pupa of *zephyrus.* Actual confirmation therefore could not be established until the following spring, when the butterflies normally emerge.

P. chlorinda chlorinda in Tasmania feeds on Silver Wattle (*Acacia dealbata*) and Blackwood (*Acacia melanoxylon*), and as far as is at present known favours fairly large trees only. The Victorian race *zephyrus* feeds on the same two species of wattle, favouring fairly large trees. The Blue Mountains form *chloris,* feeds on *Acacia ovata,* and is only to be found on large trees. It was an interesting discovery to find *Pseudalmenus* larvæ on trees varying in height from 18 inches to 25 feet, and as far as was found, on silver wattles only (*Acacia dealbata*). The same very strong smelling small black ant which occurs with the race *zephyrus* in Victoria was swarming over the larvæ and pupæ. The former fed quite openly and singly in full sunlight on the young tips of the foodplant. Pupæ were found beneath loose bark on the food trees, under stones at their bases, and even in hollow sticks nearby. In the case of larvæ found on trees only a foot or so high, the ants were followed, and in several instances led us to pupæ under the bark of eucalypts five feet away, also under leaves and pieces of wood on the ground nearby.

All the trees on which *barringtonensis* was found were growing on a slight ridge about a mile in length, and at an elevation of 4,356 feet. This differs generally from the type of locality in both Victoria and New South Wales where the species appears to favour trees growing right down in gullies. One exception is in Gippsland, Victoria, where the food trees are on a hillside.

Larvæ were in all stages of growth, from very small ones less than $\frac{1}{4}$ inch in length to fully grown ones measuring $\frac{7}{8}$ inch in length, which indicated that the butterfly apparently has a fairly long flying season. Quite a number of pupæ was also found. It was decided not to take any larvæ other than those fully grown and ready for pupation, because of the difficulties of feeding them. The pupæ were therefore placed carefully in a breeding box which was kept dark, because it had been proved from experiments with the Victorian race that if the pupæ are kept in the light they will fail to emerge.

On September 9, 1947, the first specimen, a female, emerged. This was the first record of the female. This was followed by a male, and then two more pairs in the same sequence. Coloured drawings have been made of the larvæ and pupæ by Mr. P. J. O'Brien of the National Museum.

Addendum

A stay of two weeks early this year (1948) resulting in a comprehensive survey of the northern, eastern and central portions of the Tops has yielded further data worthy of note. Adults of *barringtonensis* were seen as late as January 20, at which time larvæ were in all stages and a few pupæ were collected.

The distribution of this butterfly is quite extensive; in addition to Tubrabucca itself, life stages were collected at Tomalla, a distance of 8 miles from Tubrabucca; near the headwaters of the Tubrabucca river (1 mile distant); on the Upper Manning near the Falls (5 miles distant); and at a spot 8 miles from Tubrabucca, on the track to Mt. Barrington. In each instance all specimens were found between 4,000 and 4,600 feet elevation. At Polblue, which is 9 miles from Tubrabucca, and at an elevation of at least 5,000 feet, no larvæ or pupæ were seen, although a thorough search was made of all food trees encountered.

The male specimen described by Waterhouse in *What Butterfly is That?* on page 194 as having been picked up on the snow near Edward's Hut (elevation approx. 5,000 feet) was probably carried there by rough weather from a lower altitude.

Larvæ were collected from Blackwood trees (*Acacia melanoxylon*) near the headwaters of the Tubrabucca river, and near

the falls on the Upper Manning. As far as food plants are concerned, this brings *barringtonensis* into line with the Victorian subspecies *zephyrus.*

Larva:

Length, ⅞ inch (average), 21-23mm.

Head: Dark brownish green, small, retractile beneath the first segment.

Body: dull black suffused olive green, dorsal line very fine, pale yellow, on either side from segments 2 to 9 a broad interrupted yellow longitudinal stripe, on its inner side a paler and narrower stripe which is suffused with green, on its outer side to more than half way to lateral area another interrupted longitudinal stripe creamy yellow, faintly suffused green. Lateral marking pinkish and gradually widening from its beginning at segment 1 to segment 10 where it extends to the subdorsal region. First segment dull black suffused olive green two fine pale yellow central markings at the anterior end followed immediately by another transverse pale yellow marking which is curved backwards. Anal segment flattened, dull yellowish black tinged green, depressed centrally with a square shaped dull black marking which is connected to another transverse marking on the pre-anal segment with three fine black lines. Region immediately above the prolegs and claspers dull green. A few scattered dark brown hairs to each segment laterally and dorsally. Area immediately above prolegs and claspers clothed with fine brown hairs.

Larvæ feed quite openly during the day time on the young leaves of the foodplant; they are semi-gregarious until about one third grown, after which they feed singly. They are always attended by small black ants. Larvæ occur from November until the end of January or early February.

Pupa:

Attached by the tail and central silken girdle, found under loose bark on the food trees usually near the base, in borer holes and under sticks, leaves, and stones nearby, even in hollow logs adjacent to the food trees.

Length (average) ⅝ inch, 15-17mm.

Colour dark brownish black, almost devoid of markings, colour deeper at junction of the thorax and abdomen dorsally; abdominal segments with a darker dorsal line. Front portion flattened so that the front of the head, wing cases, and the ventral portion of the abdominal segments are in a straight line. Anal segment much flattened anteriorly. The pupal period lasts from late December until the following Spring.

Foodplant:

Silver wattle (*Acacia dealbata*).

Butterfly.

Male, Above:

Wing expanse (average) 1⅛ in.—28-29mm.

Forewing black, a broad orange band across wing, veins dusted black, a black spot at end of cell, some long silky grey hairs at base of wing, cilia greyish white.

Hindwing black, a deep orange red band from near apex to tornus, two black spots at base of tail one on each side, a few blue scales between the black spot at dorsum and the tail; some long silky grey hairs at base of wing, cilia greyish white, tail black tipped greyish white.

Beneath.

Forewing silvery white, a discal band black; another black spot at end of cell, extreme edges of wing black, cilia greyish white. Hindwing silvery white, a discal black marking to half way, a black spot at base, a cinnabar marking round termen to tornus and extending to dorsum, a minute black dot on its inner side at end, between cinnabar marking and edges of wing from one third to dorsum, black; cilia greyish white.

Female, Above:

Wing expanse (average), $1\frac{5}{16}$ in.—31-33mm.

Forewing black, a broad orange band across wing, veins not dusted black, a black spot at end of cell, a few long silky grey hairs at base of wing, cilia greyish white. Hindwing black, a broad deep orange red band from near apex to tornus, other markings as in the male.

Beneath:

As in the male, black markings wider and cinnabar marking also wider and slightly more extensive.

This race is decidedly larger than the other races and is much brighter in colour.

Locality:

Tubrabucca, Barrington Tops, New South Wales, at an elevation of from 4,000 to 4,500 feet. No doubt this butterfly occurs at many other spots on the Barrington Tops where its food trees grow on the ridges.

Holotype male in collection Waterhouse (3); Allotype female in the collection of the writer.

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6. Australian Hesperidae vii, Notes on the Types and Type Localities. *Ibid.* lxii, pp. 107-125, 1937.

PLATE No. 3.

(1). *Xenica klugi mulesi* n. subsp. Male.
(2). *Xenica klugi mulesi* n. subsp. Female.
(3). *Xenica klugi klugi* Guerin. Male.
(4). *Xenica klugi klugi* Guerin. Female.
(5). *Xenica klugi mulesi* n. subsp. Male underside.
(6). *Xenica klugi mulesi* n. subsp. Female underside.
(7). *Xenica klugi klugi* Guerin. Male underside.
(8). *Xenica klugi klugi* Guerin. Female underside.

PLATE No. 4.

(1). *Heteronympha cordace cordace* Hubn., Male.
(2). *Heteronympha cordace cordace* Hubn., Female.
(3). *Heteronympha cordace wilsoni* n. subsp., Male.
(4). *Heteronympha cordace wilsoni* n. subsp., Female.

(5). *Heteronympha cordace wilsoni* n. subsp., Male underside.
(6). *Heteronympha cordace wilsoni* n. subsp., Female underside.
(7). *Heteronympha cordace cordace* Hubn., Male underside.
(8). *Heteronympha cordace cordace,* Hubn., Female underside.

PLATE No. 5.

(1). *Trapezites sciron sciron* Whs. and Lyell, Male.
(2). *Trapezites sciron sciron* Whs. and Lyell, Female.
(3). *Trapezites sciron eremicola* n. subsp., Male.
(4). *Trapezites sciron eremicola* n. subsp., Female.
(5). *Trapezites sciron eremicola* n. subsp. Male underside.
(6). *Trapezites sciron eremicola* n. subsp. Female underside.
(7). *Trapezites sciron sciron* Whs. and Lyell. Male underside.
(8). *Trapezies sciron sciron* Whs. and Lyell. Female underside.

PLATE No. 6.

(1). *Ogyris amaryllis meridionalis* Beth. Baker, Male.
(2). *Ogyris amaryllis meridionalis* Beth. Baker, Female.
(3). *Ogyris amaryllis hopensis* n. subsp. Female. The form with the black bar at end of cell in forewing.
(4). *Ogyris amaryllis hopensis* n. subsp. Male.
(5). *Ogyris amaryllis hopensis* n. subsp. Female.
(6). *Oguris amaryllis hopensis* n. subsp. Male underside.
(7). *Ogyris amaryllis hopensis* n. subsp. Female underside.
(8). *Ogyris amaryllis meridionalis* Beth. Baker. Male underside.
(9). *Ogyris amaryllis meridionalis* Beth. Female underside.

PLATE No. 7.

(1). *Candalides heathi heathi* Cox, Male.
(2). *Candalides heathi heathi* Cox, Female.
(3). *Candalides heathi doddi* n. subsp., Male.
(4). *Candalides heathi doddi* n. subsp., Female.
(5). *Candalides heathi doddi* n. subsp. Male underside.
(6). *Candalides heathi doddi* n. subsp. Female underside.
(7). *Candalides heathi heathi* Cox. Male underside.
(8). *Candalides heathi heathi* Cox. Female underside.

PLATE No. 8.

Pseudalmenus chlorinda barringtonensis Whs.
1. Larva, Lateral view.
2. Larva, Dorsal view.
3. Pupa, Lateral view.
4. Pupa, Dorsal view.
5. Butterfly, upperside of Male.
6. Butterfly, upperside of Female (Allotype).
7. Butterfly, underside of Male.
8. Butterfly, underside of Female.

NEW RECORDS OF LEPIDOPTERA FROM VICTORIA, WITH NOTES ON SOME RARE SPECIES.

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(Received for publication June 13, 1947)

1. NEW RECORDS OF LEPIDOPTERA

Division RHOPALOCERA

Family **SATYRIDAE**

Ypthima arctous, Fab.

The normal range of this species was from Illawarra in New South Wales, to Cape York and the islands of Torres Strait, round to north western Australia.

For some years, it had been thought that *Y. arctous* might be present in far eastern Victoria, where several other New South Wales species have been recorded. The author spent a week at Mallacoota during February, 1934, and although a careful survey was made for this species it was not seen.

In January 1935, F. E. Wilson, collecting at Nowa Nowa, was fortunate in capturing specimens of both sexes of this butterfly along the Buchan road, some little distance from Nowa Nowa. The author visited the same locality in January, 1938, and collected further specimens, a little to the south of the township. Again, in early February 1947, in company with F. E. Wilson, more specimens were collected along the Buchan road. No doubt other places will be discovered in far eastern Gippsland where this butterfly will be found.

Now that enough specimens have been obtained for purposes of making accurate comparison with long series of specimens from Sydney, N.S.W., it has been found that there are no points of difference between Victorian specimens and those from other parts of Australia.

The genus *Ypthima* Hubn, contains many species of Indo-Malayan butterflies, all of which are very similar in appearance.

Ypthima arctous Fab. is the only species of the genus that occurs in Australia.

Oreixenica latialis Waterhouse & Lyell.

This species was recorded for the first time in Victoria in February, 1947, when it was taken in mid-February by F. E. Wilson

and the author near Mt. Hotham, along the road towards Cobungra, at an altitude just over 5,000 feet.

This butterfly is very abundant on Mt. Kosciusko during late February and throughout March. Waterhouse states "The butterflies there (at Mt. Kosciusko) are so plentiful that at dusk they may be picked from the bushes with the fingers." In view of this statement, it was reasonable to predict that this butterfly would occur on parts of the Victorian Alps, between 5,000 and 6,000 feet.

A closely allied species, *O. orichora orichora* Meyr. which is very similar, but slightly larger, is very plentiful at places of similar altitude on the Alps, also on Mt. Kosciusko. *O. orichora* is on the wing throughout January, but by the middle of February is nearly over. Its place is then apparently taken by *O. latialis,* as is the case at Mt. Kosciusko.

An interesting description of the life history of this butterfly is given by Waterhouse in *What Butterfly is That?* p. 115.

O. latialis was originally described as a subspecies of *Oreixenica lathoniella lathoniella* West, which has several well defined geographical races in southern Australia and Tasmania. Since then both species have been collected in the same localities at the same time. This was the case in the above instance.

Family LYCAENIDAE

Subfamily Lycaeninae

Candalides cyprotus Olliff.

This butterfly has a fairly wide distribution in Australia, being recorded from Illawarra, N.S.W. to Brisbane, the Blue Mountains, South Australia, and the southern coastal portion of Western Australia.

It was not until November 1945, however, that this species was captured in Victoria, when a few specimens were caught on the Little Desert, a few miles south of Kiata. Examples of both sexes were secured, but were in rather wasted condition, showing that it was a little late for the species. In October 1946, another visit was made to the Little Desert, and more specimens were obtained all in much better condition.

It is surprising that with such a wide range, *C. cyprotus* does not appear to have developed any geographical races. Specimens from Western Australia, South Australia, and Victoria however, are slightly smaller than those from New South Wales and Queensland.

Rarely, the central areas of the wings in the female are blue or bluish purple. In the many specimens examined by the author.

this coloration has been noted only in specimens from Brisbane. The foodplant of *C. cyprotus* in Queensland and parts of New South Wales is a leafless shrub locally known as dogwood, but in Victoria there is most likely some other foodplant. This the author suspects to be the leafless parasitic climber *Cassytha* sp. The reasons for this assumption are that a closely related species *C. hyacinthina hyacinthina* Semper. feeds on this creeper, and where *C. cyprotus* was captured in Victoria this plant was very plentiful, and a careful search for any shrub similar to the dogwood was unsuccessful.

A search was made on *Cassytha* for larvæ and pupæ, but without success. At the time, because the butterflies were on the wing, it is probable that eggs only would have been present.

Neolucia sulpitius sulpitius Miskin.

This species was first recorded from Victoria when it was collected by the author near the mouth of the Wingan Inlet, far eastern Gippsland, in February 1946.

This small butterfly has a very wide range in eastern Australia, being found commonly from Sydney to North Queensland. In the Cairns-Cooktown area the race *N. sulpitius obscura* Whs. & Lyell is taken.

It is essentially a coastal species, being found only on the mud flats or salt pans in the estuaries of rivers or creeks, where the foodplant, *Rhagodia billardieri* grows freely. There are possibly other plants allied to *Rhagodia* on which *N. sulpitius* also feeds.

It is to be expected that this small butterfly will be captured at other places along the Victorian coast, because of the occurrence of its foodplant and the number of suitable localities. Waterhouse suggests the possibility of this butterfly being a form of *Neolucia serpentata* H. Sch. which is a very similar insect, and which feeds on species of *Rhagodia* and *Atriplex*.

The author has collected the latter species at many places from Queensland to Victoria, and although found at places on the coast, it is also very abundant at localities far inland. When the two are collected together this point will be settled.

Family **HESPERIDAE**

Subfamily **Trapezitinae**

Anisynta dominula drachmophora Meyr.

This skipper butterfly is very plentiful during January and February on the Dorrigo plateau, and Barrington Tops, N.S.W.;

much rarer during the same months at Mt. Kosciusko, and at lower altitudes in Tasmania during February and March.

On account of this extended range, it was expected that it would be found on some of the higher mountains in Victoria. Therefore in late January and early February, 1946, when F. E. Wilson and the author were collecting on the Victorian Alps in the Mt. Hotham area, it was decided to explore all likely looking spots. This eventually proved successful, and a number of male specimens was captured in a grassy gully along the road towards Cobungra, at an altitude of 5,000 feet. All the specimens were in excellent condition, which showed that it was early for the species.

In 1947, the same locality was visited about the middle of February, and further specimens, including females, were obtained in the originally gully, and at another place a few miles further on, at an elevation of about 4,500 feet.

At the New South Wales localities, this butterfly frequents the grassy plains, where it comes freely to the flowers of a species of *Pimelea*; in Victoria however, this was not the case. Although numerous flowers, including *Pimelea,* were in abundance in open spots, the butterflies kept to the gullies where they rested on grass stems.

In the same areas, another rare skipper butterfly, *Oreisplanus munionga* Oll. was taken. Though abundant at Mt. Kosciusko this species is very scarce in Victoria.

Anisynta dominula dominula Plotz. was originally recorded from Tasmania and was thought to have come from the Launceston district. Most Tasmanian examples have come from Cradle Mountain where the race *pria* Whs. is found: this is much smaller than typical *dominula* or *drachmophora.* Quite recently, the author received specimens of *dominula* from southern Tasmania and near sea level; these are almost as large as *drachmophora,* and the spots on the underside are joined to form a continuous band, which would indicate that they are most probably typical *dominula.*

Examination of the Victorian specimens shows them to be rather variable, especially on the underside of the hindwing. In some specimens the spots are inclined to be silvery as in northern examples, in others creamy yellow and forming a band. Comparison of the latter type with the recently acquired Tasmanian specimens shows little difference. New South Wales specimens are darker and more richly coloured beneath and the spots are more silvery.

2. Notes on Rare Species of Lepidoptera in Victoria.

Division Heterocera.

Family **SPHINGIDAE**

Chromus erotus Cram.

This hawk moth is apparently very rare in Victoria, less than half a dozen specimens having been collected, and many years having elapsed since the last record.

A living specimen was forwarded to this Museum from Everton in the north east of Victoria, in March 1947. *C. erotus* is commoner near Sydney and Newcastle, and it occurs even more freely further north and near Brisbane.

It is the finest of the Hawk Moths to be found in Victoria, the forewings being rich brown in colour, and the hindwings orange. The family Sphingidae is poorly represented in Victoria, three species only being anything like abundant and widely distributed.

Division Rhopalocera

Family **LYCAENIDAE**

Subfamily **Lycaeninae**

Candalides Xanthospilos Hubn.

The range of this species in Australia is given as from Victoria to southern Queensland, though a few specimens have been taken as far north as Kuranda near Cairns. Its occurrence in Victoria, however, is apparently limited to a few specially favoured spots.

The late J. A. Kershaw collected several specimens of this species near Lake Tyers over 25 years ago, one other was collected at Cann River by J. Clark in 1928, and in February 1947, more specimens were taken by F. E. Wilson and the author near Lake Tyers.

It is a very common butterfly near Sydney, where it breeds on several species of *Pimelea,* chiefly *P. linifolia.* The larvæ feed at night, sheltering during the day amongst dead leaves, etc., near the base of the foodplant. The caterpillars are attended by a species of small black ant. In Victoria the foodplant is not known.

Family **HESPERIDAE**

Subfamily **Trapezitinae**

Hesperilla picta Leach.

This is another common Sydney butterfly which has extended its range down the south east coast of New South Wales into far eastern Victoria, though it is local and by no means common in the latter State.

It was found freely by the author near Wingan Inlet and near Lake Tyers during late February, 1946, and again by F. E. Wilson and the author at the last named locality in February 1947. It breeds on the Black Fruit Saw Sedge (*Gahnia melanocarpa*), which is confined to swampy gullies, usually near estuaries.

Many years ago, several specimens of *H. picta* were collected near Lake Tyers by the late J. A. Kershaw, and, as far as the author is aware it had not been taken again until 1946. The range of the species is from far eastern Victoria, along the coast of New South Wales, to south Queensland, where it is, however, rare.

ADDITIONS TO AND ALTERATIONS IN THE CATALOGUE OF THE LAND SHELLS OF VICTORIA (INCLUDING DESCRIPTIONS OF NEW SPECIES)

By C. J. Gabriel, (Honorary Conchologist, National Museum of Victoria).

(Plates 9-10).

(Received for publication June 25, 1947)

In the Proceedings of the Royal Society of Victoria Vol. XLIII, pp. 62-88, 1930, the writer published a catalogue of the Land Shells of Victoria, recording forty-five species and two varieties including eight new forms. In the interim, the list has been considerably augmented, bringing the total to 62 species and two varieties including eight new to science, the descriptions of which are now offered. Many of the additions have been located in the Gippsland area, and it is my earnest conviction that diligent search in this region will prove the existence of further species, and that they merely await the collecting. Several apparently new forms are in the cabinet of the writer but as noted in the above catalogue, with single specimens it is considered advisable to postpone descriptions until further examples appear. The present novelties, types of which have been presented to the National Museum of Victoria, are as follow: *Charopa jemmysensis, C. illustra, C. okeana, C. colliveri, C. inexpectata, C. problematica, C. lakesentranciencia, Allodiscus marysvillensis,* and special attention is drawn to the first named species, a small but most exquisite form, located with several species near Jemmy's Point, Lakes Entrance. In his Basic List of the Land Mollusca of Australia, Iredale (*loc. cit.*) has erected many New Genera, several of which appear in the present communication. The List of Introduced Forms is increased by the presence of *Vallonia pulchella* Müller, discovered at Stanhope by Mr. P. R. Johnson.

The type specimens mentioned in the 1930 Catalogue as being in the collections of the writer have now been deposited with the National Museum of Victoria.

Opportunity is here taken of expressing my best thanks to Mr. C. W. Brazenor of the National Museum for his splendid illustrations accompanying this paper.

Family RHYTIDIDAE

Genus PROLESOPHANTA Iredale, 1933.

Prolesophanta dyeri (Petterd).

1879. *Helix dyeri* Petterd, Mon. Tas. Land Shells, p. 40.
1930. *Paryphanta dyeri* Pett. Gabriel, P.R.S. Vic., XLIII, pt. 1, (N.S.), p. 71.
1933. *Prolesophanta dyeri* (Pett.), Iredale, Rec. Aust. Mus., xix, p. 40.
1938. *Id.*, Iredale, Aust. Zool., ix, p. 116.

Size of Type.—Maj. diam., 3·5; min., 2·5; alt., 1·5mm.

Localities.—Tarraville, South Gippsland (T. Worcester and C. Oke); Belgrave, Ferntree Gully, Hall's Gap Grampians (C. Oke); Olinda Falls, Splitter's Falls Lorne, Mt. Dandenong (Self); Warburton (F. E. Wilson).

Observations.—A small, glossy shell, easy of recognition. Transference to the above genus is necessary. Iredale (*loc. cit.*) regards this as incorrectly placed under *Paryphanta* remarking "The spire is a little elevated, the apical whorls roughened, the surface consists of fine radial growth lines only, the mouth is somewhat oblique, and there is no umbilicus." Not uncommon, being widely distributed throughout the state. This is a moist-loving species found nestling in moss (*Rhizogonium novaehollandiae* Brid.), and the Hepatic (*Blyttia spinosa* Gotch). Type from banks of Distillery Creek, near Launceston, Tasmania.

Genus DELOS Hutton, 1904.

Delos nelsonensis Brazier.

1871. *Helix (Hyalinia) nelsonensis* Brazier, P.Z.S. Lond., (1870), p. 661.
1871. *Helix (Paryphanta) fulgetrum* Cox, in Legrand Coll. Mon. Tas. Land Shells, sp. 31, pl. 1, fig. 11.
1894. *Rhenea nelsonensis* (Brazier). Suter, Ann. Mag. Nat. Hist., (6), xiii, p. 64.
1909. *Delos nelsonensis* (Brazier). Petterd and Hedley, Rec. Aust. Mus., vii, p. 288.
1921. *Id.*, May, Check-list Moll. Tas., p. 92, No. 904.
1923. *Id.*, May, Ill. Index Tas. Shells., pl. 42, fig. 14.

Size.—Maj. diam., 0·15; min., 0·11; alt., 0·06 of an inch.

Localities.—Mount Higginbotham (C. Oke); Mount Hotham (C. Oke).

Observations.—A thin, polished shell belonging to a genus hitherto unrecorded from Victoria. The type locality of the species is south Tasmania, but it is generally distributed throughout the island. Iredale (*loc. cit.*) notes that a little variation exists in the northern shells and figures a subspecies *abitens* which is larger but with a narrower umbilicus, the type from Launceston measuring 4mm. in breadth and 2mm in height. Iredale has

made *H. nelsonensis* Brazier the type of his new genus *Tasmadelos,* Aust. Zool., ix, p. 118, 1938.

Genus ECHOTRIDA Iredale, 1933.

Echotrida strangeoides (Cox).

1864. *Helix strangeoides* Cox, Cat. Aust. Land Shells, p. 20.
1868. *Id.,* Cox, Mon. Aust. Land Shells, p. 27, pl. 17, figs. 3, 3a, 3b.
1933. *Echotrida strangeoides* (Cox). Iredale, Rec. Aust. Mus., xix, p. 48.
1938. *Id.,* Iredale, Aust. Zool. ix, p. 117.

Size.—Maj. diam., 0·40; min., 0·33; alt., 0·15 of an inch.

Locality.—Gippsland (exact locality unknown), J. A. Kershaw (one specimen).

Observations.—A small, shining species, irregularly and rather coarsely striated; decussated above and below with numerous close-set spiral lines, a feature distinguishing it from the allied species *H. splendidula* Pfeiffer. This is an interesting addition to the Victorian fauna. Type of genus *Echotrida.*

Family **LAOMIDAE**

Genus PARALAOMA Iredale, 1913.

Paralaoma morti (Cox).

1864. *Helix morti* Cox. Ann. Mag. Nat. Hist., (3), xiv, p. 182.
1930. *Laoma morti* Cox. Gabriel, P.R.S. Vic., xliii, pt. 1 (N.S.), p. 78.
1937. *Paralaoma morti* Cox. Iredale, Aust. Zool., viii, pt. 4, p. 313.

Size.—Maj. diam., 2·03; min., 1·77; alt., 1·01mm.

Localities.—Widely distributed throughout the State.

Observations.—A small, exceedingly common species, presenting features which are subject to considerable variation, hence the heavy synonymy. It enjoys an extensive range, being recorded from New South Wales, Victoria, South Australia, Western Australia and Tasmania. Found under stones, dry timber and fallen leaves. The description of the genus appears in P. Mal. Soc. Lond., x, 1913, p. 380. Haplotype, *P. raoulensis* from Sunday Island, Kermadec Group.

Paralaoma mucoides (Tenison Woods).

1879. *Helix mucoides,* Tenison Woods, P.L.S., N.S.W.. iii, p. 125, pl. 12, figs. 5, 5a.
1930. *Laoma mucoides* (T. Wds.). Gabriel, P.R.S., Vic. xliii, pt. 1, (N.S.). p. 79.
1937. *Paralaoma mucoides* (T. Wds.). Iredale, Aust. Zool, viii, pt. 4, p. 314.

Size of Type.—Maj. diam., 3; min. 2·5; alt., 1·5mm.

Localities.—Melbourne (Type); Meredith (J. H. Young); Gong Gong Reservoir (C. Oke); Trentham Falls (J. K. and R. C. Gabriel); Splitters' Falls Lorne (Self).

Observations.—In form and sculpture a close ally of *L. morti* Cox. Both species possess radial lamellæ, which are less developed in *L. mucoides.* The last whorl is obtusely carinated, a feature absent in *L. morti.*

Type in Australian Museum, Sydney.

Paralaoma halli (Cox).

1871. *Helix* (*Rhyssota*) *halli* Cox, in Legrand Coll. Mon., sp. 34, pl. 2, fig. 9.
1930. *Laoma halli* Cox. Gabriel, P.R.S. Vic. xliii, pt. 1, (N.S.), p. 81.
1937. *Paralaoma halli* (Legrand). Iredale, Aust. Zool, viii, pt. 4, p. 314.

Size of Type.—Maj. diam., 1·52; min., 1·26; alt., 1·01mm.

Localities.—Castlemaine (F. L. Billinghurst); Frankston and Tarraville (T. Worcester); Ferntree Gully, Mt. Donna Buang (C. Oke); Trentham Falls (J. K. and R. C. Gabriel); Grampians, Lorne (Self); French Island (A. R. Trebilcock).

Observations.—A minute form, found under decaying wood, and in moss. Narrowly umbilicated and finely striated. It is widely distributed in Victoria. Consistency in shape is not apparent, as considerable variation is seen, more particularly in regard to height. Iredale (*loc. cit.*) regards Legrand as the author of the species.

Genus LAOMAVIX Iredale, 1933.

Laomavix collisi (Brazier).

1868. *Helix minima* Cox, Mon. Aust. Land Shells, p. 10, pl. 12, fig. 8. (non *Helix minima* Schlotheim, Min. Tasch., p. 340, 1818) (non *Helix minima* H. Adams P.Z.S. Lond., p. 303, 1867).
1877. *Helix* (*Pitys*) *collisi* Braz., P.R.S. Tas., for 1876, p. 168.
1930. *Laoma minima* Cox. Gabriel, P.R.S. Vict., XLIII, pt. 1 (New Series), p. 80.
1933. *Thryasona diemenensis* Cox. Iredale, Rec. Aust. Mus., XIX, p. 54.
1937. *Id.*, Iredale, Aust. Zool., VIII, p. 315.

Size of Type.—Maj. diam., 1·77; min., 1·52; alt., 0·76mm.

Localities.—Bairnsdale and Tarraville (T. Worcester); Carrum (C. Oke); Jemmy's Point Lakes Entrance under stones, decayed timber and fallen leaves (Self).

Observations.—A small, shining, broadly umbilicated species, with nothing comparable in Victoria. Further study of this peculiar little shell convinces one of its misplacement in *Laoma,* and the writer is in agreement with Iredale that a new genus is necessary for its reception and *Laomavix* is now adopted. Cox's name being invalid, the shell will be known as above. Type of *H. minima* Cox is in the Australian Museum, Sydney.

Genus MISELAOMA Iredale, 1933.

Miselaoma sinistra (Gabriel).

1930. *Laoma sinistra* Gabriel, P.R.S., Vic., XLIII, (N.S.), pt. 1. p. 81, pl. 2, fig. 8.
1937. *Miselaoma sinistra* (Gabriel), Iredale, Aust. Zool., VIII, p. 316.

Size of Type.—Maj. diam., 1·0; min., 1·0; alt., 1·2mm.

Localities.—Tarraville (Type, T. Worcester); Ferntree Gully (C. Oke).

Observations.—A peculiar sinistral form. In 1933 Rec. Aust. Mus. XIX, p. 53, Iredale erected this genus for the reception of the Tasmanian *Helix weldii* Tenison Woods, naming it as the Type, and later (*loc. cit.*) included *Laoma sinistra* mihi, from Victoria. These two species are somewhat similar, the Tasmanian form being a much broader shell. This interesting genus is further represented by *M. reevesbyi* Cotton from Reevesby Island, South Australia. Type of *M. sinistra* in National Museum, Victoria.

Genus TROCHOLAOMA Iredale, 1937.

Trocholaoma parvissima (Cox).

1871. *Helix* (*Conulus*) *parvissima* Cox, in Legrand Coll. Mon. Tas. Land Shells, sp. 39, pl. 2, fig. 1.
1879. *Helix parvissima* Cox. Petterd, Mon. Tas. Land Shells, p. 22, sp. 33.
1894. *Endodonta parvissima* (Cox). Pilsbry, Mon. Conch., IX, p. 34.
1896. *Endodonta parvissima* (Cox). Hedley, Rec. Aust. Mus., II, p. 104.
1909. *Laoma parvissima* (Cox). Petterd and Hedley, Rec. Aust. Mus., VII, p. 296.
1921. *Id.*, May, Check-List Moll. Tas., p. 95, No. 928.
1923. *Id.*, May Ill., Index Tas. Shells, pl. 43, fig. 13.
1937. *Trocholaoma parvissima* (Legrand). Iredale, Aust. Zool., VIII, pt. 4, p. 316.

Size.—Maj. diam., 0·05; min., 0·04; alt., 0·06 of an inch.

Localities.—Victoria (Iredale); Trentham Falls (J. K. and R. C. Gabriel).

Observations.—A minute, conical species not comparable with any Victorian form. The Trentham record is based on two fragmentary specimens found in moss near the falls and although a trifle smaller, they appear to represent the series. The author's locality is near Brown's River, Tasmania, but is generally distributed throughout the island. It is also recorded from Mt. Kosciusko, New South Wales. *Helix spiceri* Petterd from Tasmania is selected as the type of the genus.

Genus TURBOLAOMA Iredale, 1937.

Turbolaoma turbinuloidea (Gabriel).

1930. *Laoma turbinuloidea* Gabriel, P.R.S. Vic., XLIII (N.S.), pt. 1, p. 81, pl. 2, fig. 7.
1937. *Turbolaoma turbinuloidea* (Gabriel). Iredale, Aust. Zool., VIII, p. 317.

Size of Type.—Maj. diam., 2·2; min., 2·2; alt., 2·0mm.

Locality.—Bairnsdale (T. Worcester).

Observations.—A small, umbilicated, shining, thin, chocolate-brown, turbinately-globose shell, with nothing approaching it in Victoria. So strikingly peculiar is this form that in the original description a suggestion was made that the species may represent a new genus. Naming the above as the type, Iredale erected *Turbolaoma* and added "the species differs in its few very rounded whorls with deep sutures, very fine sculpture, thin shell, rather rounded mouth, deep narrow umbilicus, columella reflected, and may not even be related to the Laomid Shells proper." Type in National Museum, Victoria.

Family **FLAMMULINIDAE**

Genus THRYASONA Iredale, 1933.

Thryasona diemenensis (Cox).

1868. *Helix diemenensis* Cox, P.Z.S. Lond., for 1867, p. 723.
1930. *Charopa diemenensis* (Cox). Gabriel, P.R.S. Vic., XLIII, Pt. 1, (N.S.), p. 75.
1933. *Thryasona diemenensis* (Cox). Iredale, Rec. Aust. Mus., XIX, p. 54.
1937. *Id.*, Iredale, Aust. Zool., VIII, Pt. 4, p. 318.

Size of Type.—Maj. diam., 9·39; min., 8·37; alt., 3·55mm.

Locality.—Mount William (Nat. Mus. Vic.), collected by J. Clark, (one specimen).

Observations.—A shell with numerous riblets and many radiate pale-red bands. It is common in Tasmania and on the islands in Bass Strait. From the reference list, 1930, it is obvious the generic location of the shell has proved a difficulty and the writer concurs with Iredale in his treatment as above. This is the orthotype of the genus.

Thryasona elenescens (Cox and Hedley).

1912. *Flammulina elenescens* Cox and Hedley, Mem. Nat. Mus. Melb., No. 4, p. 12, pl. 3, figs. 16-18.
1930. *Charopa elenescens* (Cox and Hedley). Gabriel, P.R.S. Vic., XLIII, pt. 1, (N.S.), p. 75.
1937. *Thryanosa elenescens* (Cox and Hedley). Iredale, Aust. Zool., VIII, pt. 4, p. 319.

Size of Type.—Maj. diam., 6·7; min., 5·4; alt., 2·9mm.

Localities.—Merri Creek (Tenison Woods); Preston (C. L.

Barrett); Geelong (H. W. Davey); Sunshine (J. E. Dixon); Broadmeadows.

Observations.—A rather flat species with a broad umbilicus. The authors describe the colour as ochraceous-buff, with a few faint radial streaks of brown, and remark: "in general appearance like *F. diemenensis* and *F. marchianae,* between which it is intermediate in size. The break in sculpture of *F. elenescens* readily distinguishes it." It is a species easy of recognition. Type in Australian Museum Sydney.

Genus THALASSOHELIX Pilsbry, 1892.

Thalassohelix translucens Gabriel.

1934. *Thalassohelix translucens* Gabriel, Mem. Nat. Mus. Vic., VIII, p. 157, pl. 18, figs. 1-3.

Size of Type.—Maj. diam., 14·5; min. diam., 12mm.

Locality—Lilly Pilly Gully, National Park, Wilson's Promontory (under logs), (J. A. Kershaw).

Observations.—The other member of the genus in Victoria is *T. fordei* (Braz.) var. *m'coyi* (Petterd), a form frequently located in the Dandenong ranges. *T. translucens* may be distinguished by a more angled periphery and by its zigzag colour bands; the latter character, where a little variation exists is more evident in the paratype than in the holotype. This species is placed by Iredale in his genus *Mulathena,* Aust. Zool., IX., p. 1, 1937, a genus erected by the author Rec. Aust. Mus. XIX, p. 53, 1933 with *Helix fordei* Brazier as Type.

Family **ENDODONTIDAE**

Genus CHAROPA Albers, 1860.

Charopa ricei (Brazier).

1871. *Helix* (*Charopa*) *ricei* Brazier, P.Z.S. Lond. (1870), p. 660.
1871. *Helix rotella* Brazier, *op. cit.* (colour variation).
1871. *Helix* (*Charopa*) *onslowi* Braz., P.Z.S. Lond. (1870).
1871. *Id.,* Brazier, in Legrand Coll. Mon., sp. 46.
1894. *Endodonta* (*Charopa*) *ricei* (Braz.). Pilsbry. Man. Conch., IX, p. 34.
1901. *Helix* (*Charopa*) *onslowi* Braz. Ancey, Journ. de Conch. XLIX, p. 146, footnote.
1909. *Endodonta ricei* (Brazier), Petterd and Hedley, Rec. Aust. Mus., VII (4), p. 291, pl. 83, figs. 11-13.
1921. *Id.,* May. Check-List Moll. Tas., p. 93, No. 914.
1923. *Id.,* May, Ill. Index Tas. Shells, pl. 43, fig. 1.

Size.—Maj. diam., 0·18; min., 0·14; alt., 0·11 of an inch.

Locality—Lakes Entrance (T. Worcester).

Observations.—A finely sculptured species. Petterd and Hedley (*loc. cit.*) note "This is usually known by the name of *H.*

legrandi Cox. Authors have compared it with *H. juloidea* Forbes, but it more nearly approaches *H. funerea* Cox, from which it differs by narrower umbilicus, greater height in proportion to diameter and finer sculpture." With the excellent illustrations provided by these authors, no difficulty should be experienced in identifying the species.

Charopa inusta (Cox).

1866. *Helix nautilodea* Cox, Journ. de Conch., XIV, p. 47, January 1.
1866. *Helix nautilodes* Cox, P.Z.S. Lond. (1865), p. 696, April 24.
1868. *Helix inusta* Cox, Mon. Aust. Land Shells, p. 13, pl. 10, fig. 3. nom. nov. for *H. nautilodoea* Cox and *H. nautilodes* Cox. non. *H. nautilodes* Ferussac, Hist. Nat. Moll, i, p. 191, 1850.
1886. *Charopa inusta* Cox. Tryon, Man. Conch., 11, p. 209, pl. 62, figs. 21, 22.
1894. *Endodonta nautiloides* Cox. Pilsbry, Man. Conch., IX, p. 34.
1894. *Endodonta inusta* (Cox). Pilsbry, Man. Conch., IX, p. 34.

Size.—Maj. diam., 0·23; min., 0·19; alt., 0·12 of an inch.

Locality.—Merri Creek (J. A. Kershaw).

Observations.—A dull reddish-brown shell, closely allied to *H. sericatula* Pfr. but a smaller, and a more finely ribbed species. This Victorian record is based on a single, perfect specimen presented to the writer by the late Mr. J. A. Kershaw.

Charopa subrugosa Brazier.

1871. *Helix* (*Pitys*) *subrugosa* Brazier, in Legrand Coll. Mon., sp. 68.
1871. *Id.*, Braz. P.Z.S. Lond., p. 697.
1879. *Helix subrugosa* Braz. Petterd, Mon. Tas. Land Shells, p. 35, sp. 53.
1894. *Endodonta* (*Charopa*) *subrugosa* Braz. Pilsbry, Man. Conch. IX, p. 35.
1909. *Endodonta subrugosa* (Braz.). Petterd and Hedley, Rec. Aust. Mus., VII (4), p. 292.
1921. *Id.*, May, Check List Moll. Tas., p. 94, No. 916.
1923. *Id.*, May, Ill. Index Tas. Shells, pl. 43, fig. 3.

Size of Type—Maj. diam., $1\frac{3}{4}$; min., $1\frac{1}{2}$; alt., 1 line.

Locality.—Victoria, exact locality unknown (J. A. Kershaw).

Observations.—This is recorded from several localities in Tasmania. The author remarks "Of this beautiful species I received two samples from Mr. Petterd, collected by him near Hobart Town; it may be distinguished from any other known species by the bold projecting out of the ribs, by the interstices being of finer sculpture, and the depressed and furrowed appearance of the last whorl just above the periphery." Petterd (*loc. cit.*), notes, "The sculpture represents *H. matthinæ* (mihi) in miniature by its widely separated bold striæ and striated interstices. The striæ vary somewhat in prominence and compactness, so much so that Mr. Beddome, at one time, thought it would be advisable to create a new species for the specimens from The Blue Tier under the name of *H. kannariæ,* but after careful examination with a large

series of examples I am confident that it is but an individual variation." Iredale, Aust. Zool, VIII, pt. 4, p. 328, 1937, has made *Helix subrugosa* Legrand the type of his new genus *Kannaropa.*

Charopa jemmysensis sp. nov. (Pl. 9, Fig. 1).

Shell small, discoidal, light horn-colour, widely umbilicated, distinctly distantly ribbed. Apex slightly sunken. Whorls, including protoconch, about four and one half, convex, last whorl slightly descending. Sutures well impressed. Sculpture consisting of subequidistant radial ribs about thirty two on the ultimate whorl; interstices bearing minute and numerous growth-lines, reticulated by fine microscopic spiral striæ. Protoconch finely radially ribbed. Aperture oblique, rotundly lunate. Peristome simple, acute, callus on the previous whorl distinct, concealing several of the ribs. Umbilicus deep, exposing all the volutions and on which the radial sculpture may be clearly seen.

Size of Type.—Maj. diam., 2·5; min., 2·2; alt., 1·1mm.

Locality—Type, near Jemmy's Point, Lakes Entrance (Self); Mitchell Gorge one specimen (C. Oke); Tarra Valley one specimen (C. Oke).

Observations.—This ornate little species may not be confused with any Victorian form. Its nearest ally is *C. subrugosa* Brazier, a shell of somewhat similar sculpture, but from which it may be distinguished by its much flatter form. Considerable variation exists as regards colour, one specimen appearing almost an albino. Found at the first named locality a little above tide mark under logs and decaying leaves. Type in collections of National Museum of Victoria. Reg. No. F. 1054.

Charopa illustra sp. nov. (Pl. 9, Fig. 2.)

Shell small, discoidal, light brown, umbilicated. Whorls, including protoconch about four and one half, fairly-regularly radiately ribbed, about eighty appearing on the ultimate whorl which is slightly descending. Interstices microscopically finely reticulated. Sutures well impressed. Aperture broadly lunar. Peristome acute. Inner lip with a shining white glaze covering several of the ribs. Umbilicus moderately wide, deep, showing all the volutions and with the radial sculpture easily discernible.

Size of Type.—Maj, diam., 3·1; min., 2·5; alt., 1·3mm.

Locality.—Type with several paratypes found under logs at end of north arm, Lakes Entrance (Self).

Observations.—This species may be confused with *H. legrandi* Cox from Tasmania but is readily distinguished by its smaller umbilicus. A similarity to *Charopa tarravillensis* (mihi) appears, the novelty being a much flatter shell. Type in collections of the National Museum of Victoria. Reg. No. F. 1056.

Charopa okeana sp. nov. (Pl. 9, Fig. 3.)

Shell small, thin, discoidal, umbilicated, closely ribbed, light brown with numerous, very faint, subequidistant, radiating reddish-brown colour bands.

Whorls including protoconch five, convex. Sutures impressed. Sculpture consisting of very close, lightly curved axial riblets, approximately two hundred on the ultimate whorl. Interstices possessing very few growth lines reticulated by dense microscopic spiral striæ, a feature visible only under high magnifying power. Umbilicus wide, about one third of the greatest diameter of the shell, exposing all the earlier volutions and the very fine radial sculpture. Aperture roundly- lunar. Peristome thin, sharp. Inner lip with definite callus glaze, concealing numerous riblets.

Size of Type—Maj. diam, 4·3; min., 3·9; alt., 2·0mm.

Localities.—Type. Mount Feathertop, 6,136 feet (C. Oke); Mount Higginbotham, 6,000 feet (C. Oke).

Observations.—Two paratypes with colour bands barely discernible are in the collection of the writer. The species somewhat resembles *C. albanensis,* Cox, from which it may be separated by its finer sculpture and flatter form. I have much pleasure in associating with this interesting novelty the name of Mr. C. Oke who has rendered such valuable assistance in the collecting of these puzzling land forms. Type in the collections of the National Museum of Victoria. Reg. No. F. 1058.

Charopa colliveri sp. nov. (Pl. 9, Fig. 4.)

Shell small, light brown, thin, perforated, spire lightly raised. Sculpture distinct. Whorls including protoconch four and one half, ornamented with prominent, subequidistant, slightly curved radial ribs about sixty on the ultimate whorl which is descending considerably below the level of the penultimate. Interstices with few microscopic growth lines and crowded concentric striæ. Sutures impressed. Entering the extremely narrow umbilicus the radial sculpture is clearly perceptible. Aperture oblique, rotundly lunate. Peristome thin and sharp. Inner lip with callus glaze concealing several of the ribs.

Size of Type.—Maj. diam., 2·5; min., 2·2; alt., 1·2mm.

Localities.—Type under logs at end of north arm Lakes Entrance (Self); Snuff Gully near Lake Tyers and Buchan (Self).

Observations.—With no Victorian species could this be confused. It somewhat approaches *H. cochlidium* Cox from Clarence River, New South Wales a species with fewer ribs and a comparatively wide umbilicus. The colour is not constant, one specimen in the cabinet of the writer being almost white. In connecting the name of my friend Mr. F. S. Colliver with this beautiful little shell, it is done so in appreciation of his enthusiasm and work on Victorian conchology. Type in the collections of the National Museum of Victoria. Reg. No. F. 1060.

Charopa inexpectata sp. nov. (Pl. 10, Fig. 5.)

Shell minute, discoid, depressed, umbilicated, fragile, white, silky. Whorls, including protoconch four, rounded. Sculpture consisting of equidistant, fine, radial riblets to the number of one hundred and ten on the ultimate

whorl. Interstices microscopically reticulated. Sutures well defined. Umbilicus wide, nearly one third of diameter of shell, volutions well exposed, with radial sculpture clearly discernible. Aperture oblique, narrowly lunate. Peristome acute, simple. Inner lip not reflexed, parietal wall with a broad shining glaze, concealing several riblets.

Size of Type.—Maj. diam., 1·3; min., 1·1; alt., 0·5mm.

Locality.—Michel Dene, Marysville under decaying timber (Self).

Observations.—This tiny species is the smallest of our Victorian *Charopid* forms and is easily separable by its fine sculpture and diminutive size.

Type in the collections of the National Museum of Victoria. Reg. No. F. 1062.

Charopa lakesentranciencia, sp. nov. (Pl. 10, Fig. 6.)

Shell minute, white, thin, fragile, subdiscoidal, spire just slightly elevated, umbilicated. Whorls, including protoconch, about four and one half, rounded. Sculpture consisting of subequidistant, radial, fine, slightly-curved riblets, about sixty on the last whorl. Interstices with minute growth lines averaging eight to ten, reticulated by fine concentric striæ. Last whorl descending below the level of the penultimate whorl. Sutures impressed. Umbilicus about one quarter of shell's greatest diameter, volutions well exposed with sculpture clearly seen even to apex. Aperture lunate. Peristome simple, acute. Inner lip not reflexed, callus glaze concealing about four of the radial riblets.

Size of Type.—Maj. diam., 2·3; min., 2·0; alt., 1·2mm.

Localities—Type. End of North Arm Lakes Entrance under decaying timber (Self); Jemmy's Point, Lakes Entrance (Self).

Observations.—A delicate form which could not be confused with any known Victorian species. Type in the collections of the National Museum of Victoria. Reg. No. F. 1063.

Charopa problematica sp. nov. (Pl. 10, Fig. 7.)

Shell small, thin, discoid, umbilicated, closely radiately ribbed. Colour brown, with irregularly-spaced white streaks extending to the umbilicus. Whorls including protoconch about four and one half, rounded, slowly and regularly increasing, the ultimate very slightly descending, almost on the plane of the shell. Sutures well defined. The shell is sculptured with radial ribs to the number of about one hunded and fifty on the last whorl. Interstices with very fine radial riblets averaging about six. Umbilicus wide, broadly conical, about one third of the shell's greatest diameter, volutions with radial sculpture clearly discernible. Aperture roundly lunate. Peristome thin, sharp. Inner lip not reflexed; callus glaze broad and thin, concealing several ribs.

Size of Type.—Maj. diam., 2·2; min., 2·0; alt., 0·8mm.

Locality.—Type. Fernshaw (W. Kershaw).

Observations.—A pretty little species comparable with *C. tamarensis* (Petterd) from which it may be distinguished by its flatness and smaller size. Reference is here made that this species

with several others recorded in this communication were presented to the writer by that keen land shell enthusiast, to whom I am much indebted—the late Mr. J. A. Kershaw.

Type in the collections of the National Museum of Victoria. Reg. No. F. 1065.

Genus EGILODONTA Iredale, 1937.

Egilodonta bairnsdalensis Gabriel.

1930. *Charopa bairnsdalensis* Gabriel. P.R.S. Vic., XLIII (N.S.), pt. 1, p. 78, pl. 2, figs. 11, 12.

1937. *Egilodonta bairnsdalensis* (Gabriel). Iredale, Aust. Zool. VIII, p. 328.

Size of Type—Maj. diam., 2·0; min., 1·8; alt., 0·9mm.

Localities.—Bairnsdale (Type, T. Worcester); Jemmy's Point, Lakes Entrance (Self).

Observations.—The type and two paratypes are imperfect. It is a beautifully sculptured form found alive at the latter locality, a little above tide mark under logs and decaying leaves, in association with the new species *Charopa jemmysensis.* Its removal to the above genus is obvious, as Iredale points out "the mouth shows a long entering palatal lamella, and another shorter basal one, a feature not noticed in the original description." (Type of Genus.) Externally somewhat approaches *H. cochlidium* Cox, but is flatter and possesses a larger umbilicus.

Genus OREOMAVA Iredale, 1933.

Oreomava otwayensis Petterd.

1879. *Helix otwayensis* Petterd, Mon. Tas. Land Shells (April), p. 39.

1930. *Allodiscus otwayensis* Pett. Gabriel, P.R.S. Vic., XLIII, pt. 1, (N.S.), p. 82.

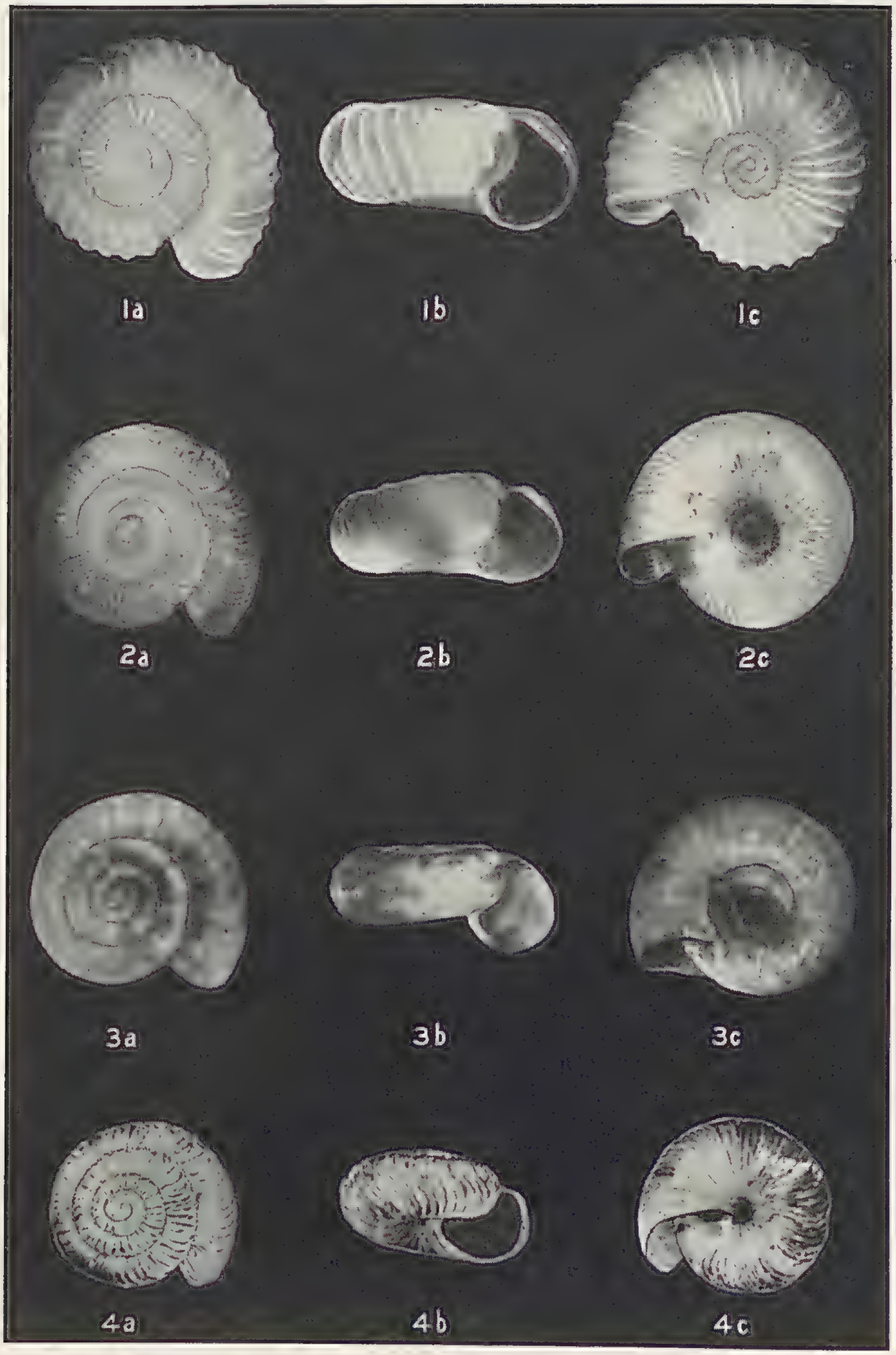
1933. *Oreomava otwayensis* (Pett.). Iredale, Rec. Aust. Mus., XIX, p. 54.

1937. *Id.,* Iredale, Aust. Zool., VIII, p. 330.

Size of Type.—Maj. diam., 2; min., 1·5; alt., 1mm.

Localities.—Cape Otway (Petterd); Fernshaw (Kershaw); Ferntree Gully, Gong Gong Reservoir, Mt. Erica, Warburton, Mitchell Gorge (C. Oke); Taggerty (Nat. Mus. Vic.); Tarraville (T. Worcester); Mt. Dandenong, Marysville (Self).

Observations.—An ornate little species, imperforate and with the interstices minutely decussate. The type locality is Cape Otway scrubs. Johnston in Petterd (*loc. cit.*) records a variety from north west Tasmania and remarks "Two specimens obtained by T. R. Atkinson and myself in the vicinity of Surrey Hills nearly 2,000 feet above the sea level. It is nearly twice the size of its Victorian representative, and the sculpture is proportionately coarser. On this account, and as it is new to Tasmania, I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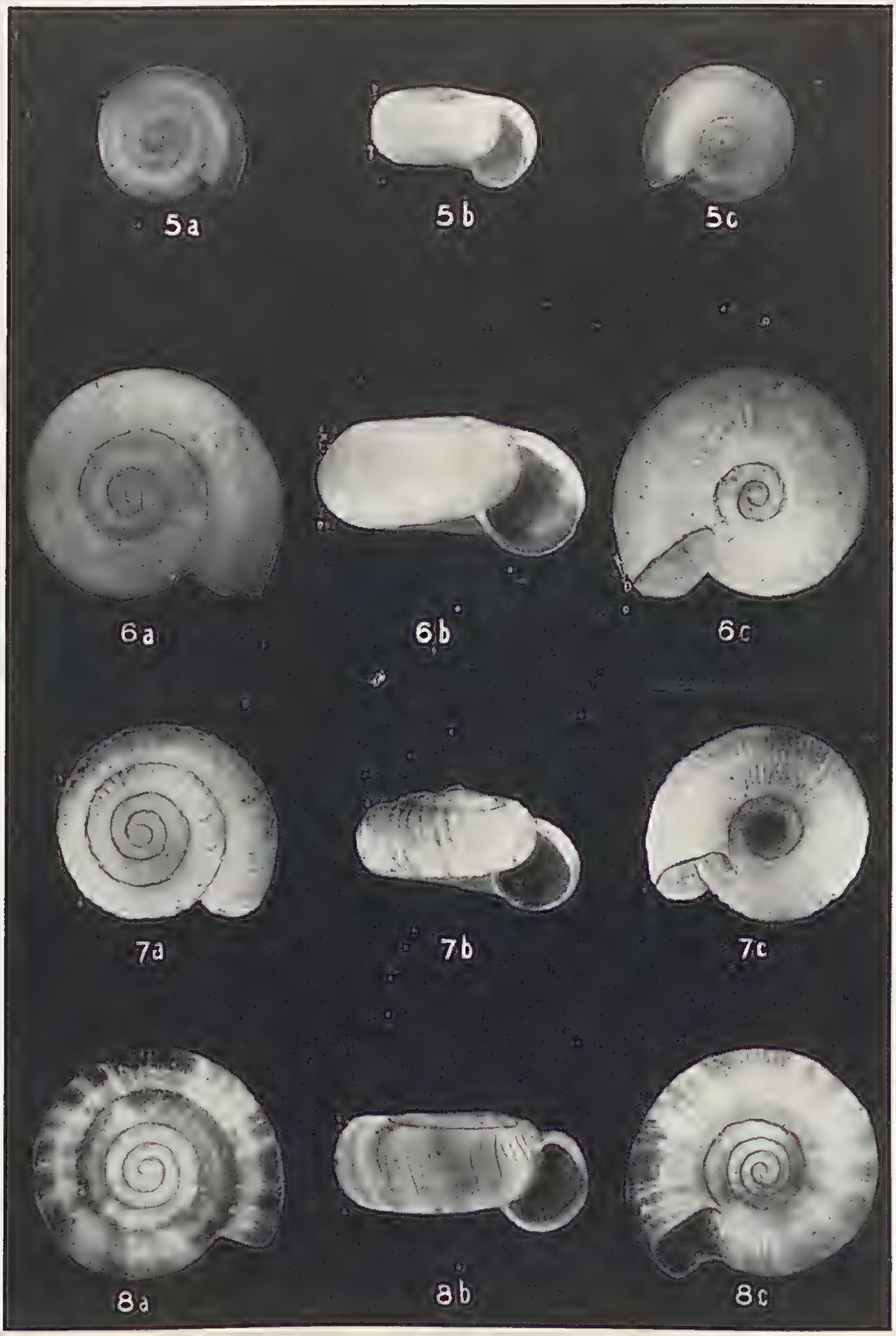


ERRATA

Some figures on Plate X are transposed:

Allodiscus marysvillensis, p. 122, should read Fig. 6.
Charopa lakesentranciencia, p. 119, should read Fig. 7.
Charopa problematica, p. 119, should read Fig. 8.

propose *alpina* as the name of the variety." *Alpina* being preoccupied, Iredale (*loc. cit.*) has renamed it *Oreomava johnstoni.* Petterd's species is fairly abundant, easily recognisable and could not be confused with any Victorian form. Larger specimens exist, the type dimensions of which are exceeded in a specimen from Ferntree Gully, which measures 3mm. This is the Orthotype of *Oreomava.*

Oreomava cannfluviatilus Gabriel.

1929. *Allodiscus cannfluviatilus* Gabriel, Vic. Nat, XLVI, (6), p. 133, figs. 1, 2, and text fig.
1930. *Id.*, P.R.S. Vic., XLIII, Pt. 1, (N.S.), p. 83.
1937. *Oreomava cannfluviatilus* (Gabriel). Iredale, Aust. Zool., VIII, p. 330.

Size of Type.—Maj. diam., 2·8; min., 2·4; alt., 1·7mm.

Localities.—Type, Cann River (Nat. Mus. Vic.) collected by J. Clark; Snuff Gully near Lakes Entrance (Self), under decaying timber.

Observations.—A distinctive little form. Bordering the umbilicus, several rather strong spiral liræ are evident; this is a constant feature, providing a helpful and striking diagnostic character. Compared with *Helix otwayensis* Petterd, it may be distinguished by its fewer ribs, and the presence of an umbilicus. Found in association with *Flammulina excelsior* Hedley, *Charopa tamarensis* (Petterd), and *Rhytida ruga* (Cox).

Genus ALLODISCUS Pilsbry, 1892.

Allodiscus dandenongensis Petterd.

1872. *Helix (Charopa) subdepressa* Brazier, P.Z.S. Lond., 1871, p. 641 (*non Helix subdepressa* Orbigny, Prod. Palaeont., III, p. 1, 1852).
1879. *Helix dandenongensis* Petterd, Journ. of Conch., II, p. 355.
1930. *Allodiscus subdepressus* (Brazier). Gabriel, P.R.S., Vic., XLIII, pt. 1, (N.S.), p. 82.

Size of Type.—Maj. diam., 3·17; min., 2·11; alt., 1·05; diameter of umbilicus, 1·58mm.

Localities.—Snowy River and Fernshaw (Kershaw); Dandenong Range (Petterd and Self); Oakleigh (C. French); Gembrook (Coghill); Emerald District (Jarvis); Yarragon (Nat. Mus. Vic.); S. Gippsland (Rev. G. Cox); Korumburra (F. L. Billinghurst); Meredith (J. H. Young); Balook and Mt. Erica (C. Oke); Marysville, Hordern Vale, Lorne (Self); Trentham (J. K. and R. C. Gabriel).

Observations.—A white shell, with an umbilicus equalling more than half the diameter. It is of gregarious habit, being commonly located in large numbers under decayed timber and among moss. Many more localities could be recorded but the above are sufficient

EXPLANATION OF PLATES 9 AND 10.

Fig. 1. *Charopa jemmysensis* sp. nov. Type. Reg. No. F. 1054, near Jemmy's Point, Lakes Entrance.

Fig. 2. *Charopa illustra* sp. nov. Type. Reg. No. F. 1056, end of North Arm, Lakes Entrance.

Fig. 3. *Charopa okeana* sp. nov. Type. Reg. No. F. 1058, Mount Feathertop.

Fig. 4. *Charopa colliveri* sp. nov. Type. Reg. No. F. 1060, end of North Arm, Lakes Entrance.

Fig. 5. *Charopa inexpectata*, sp. nov. Type. Reg. No. F. 1062. Michel Dene, Marysville.

Fig. 6. *Charopa lakesentranciencia* sp. nov. Type. Reg. No. F. 1063, end of North Arm, Lakes Entrance.

Fig. 7. *Charopa problematica* sp. nov. Type. Reg. No. F. 1065, Fernshaw.

Fig. 8. *Allodiscus marysvillensis* sp. nov. Type. Reg. No. F. 1066, near Wolfram Mine, Marysville.

a.—Upper surface. b.—Side view. c.—Lower surface.

A NEW LEAF-HOPPER FROM VICTORIA (HOMOPTERA, JASSIDAE).

By J. W. Evans, M.A., D.Sc., F.R.E.S.
Imperial Institute of Entomology, London.

Fig. 1.

(Received for publication June 27, 1947).

The leaf-hopper which is described below is very plentiful around Melbourne, Victoria, where it occurs commonly on grass.

Family **JASSIDAE**
Subfamily **Euscelinae**
Tribe Balcluthini

Nesoclutha gen. nov.

The ante-clypeus projects well beyond the lora and maxillary plates, and the vertex is rounded apically. The crown of the

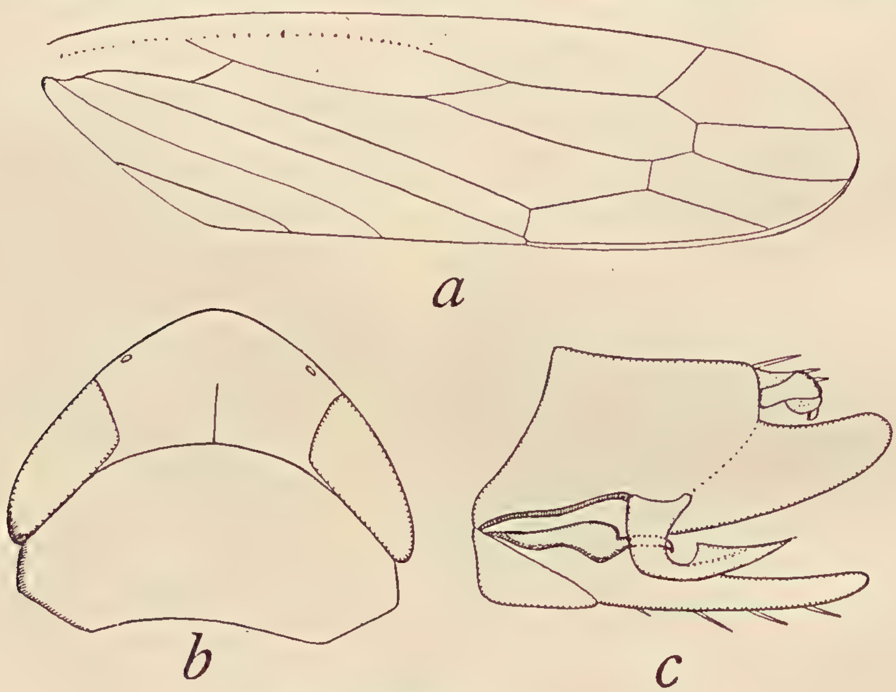


Fig. 1. *Nesoclutha obscura* n. sp.
a. Tegmen.
b. Head and pronotum, dorsal aspect.
c. Male genitalia.

head is wide. The ocelli, which are small, are marginal in position and are situated slightly in front of the level of the apex of the cornal suture. The anterior margin of the pronotum is only slightly curved and is approximately parallel with the hind margin.

Nesoclutha obscura sp. nov.

Length 5mm. General coloration (dried specimens) pale stramineous. Scutellum, white with orange markings. Tegmen hyaline, veins whitish. Male genitalia as in Fig. 1, c.

Type from Melbourne, Australia (O. W. Tiegs) 1/47, in the British Museum. Paratypes in the National Museum of Victoria, Melbourne.

A NEW SNAKE FROM TOROKINA, BOUGAINVILLE ISLAND.

By C. W. Brazenor, Mammalogist, National Museum of Victoria.

Fig. 1.

(Received for publication July 7, 1947).

Mr. R. Clarke, of Melbourne, Victoria, brought to the Museum a number of reptiles collected during his war service on Bougainville, Solomon Islands. Amongst them are three snakes, belonging to the genus *Denisonia,* which do not fit the descriptions of either of the species previously described from that area. They are therefore recorded as

Denisonia furva sp. nov.

Eye two-thirds as long as its distance from the mouth. Rostral much broader than deep; well visible from above. Internasals about two-thirds the length of the prefrontals, which are broader than long. Frontal a little longer than broad; more than twice as broad as the superoculars; one-and-a-half times as long as the prefrontals, and three-quarters the length of the parietals. Nasal a single scale, but showing a fold above the nostril; in contact with a single preocular. One postocular. Temporals 1 + 1. Six upper labials, the third and fourth entering the eye and the fifth largest. Six lower labials, four in contact with the anterior chin shields which are about as long as the posterior. Anal divided. Scales in 15 rows; ventrals 164; subcaudals 32, all paired.

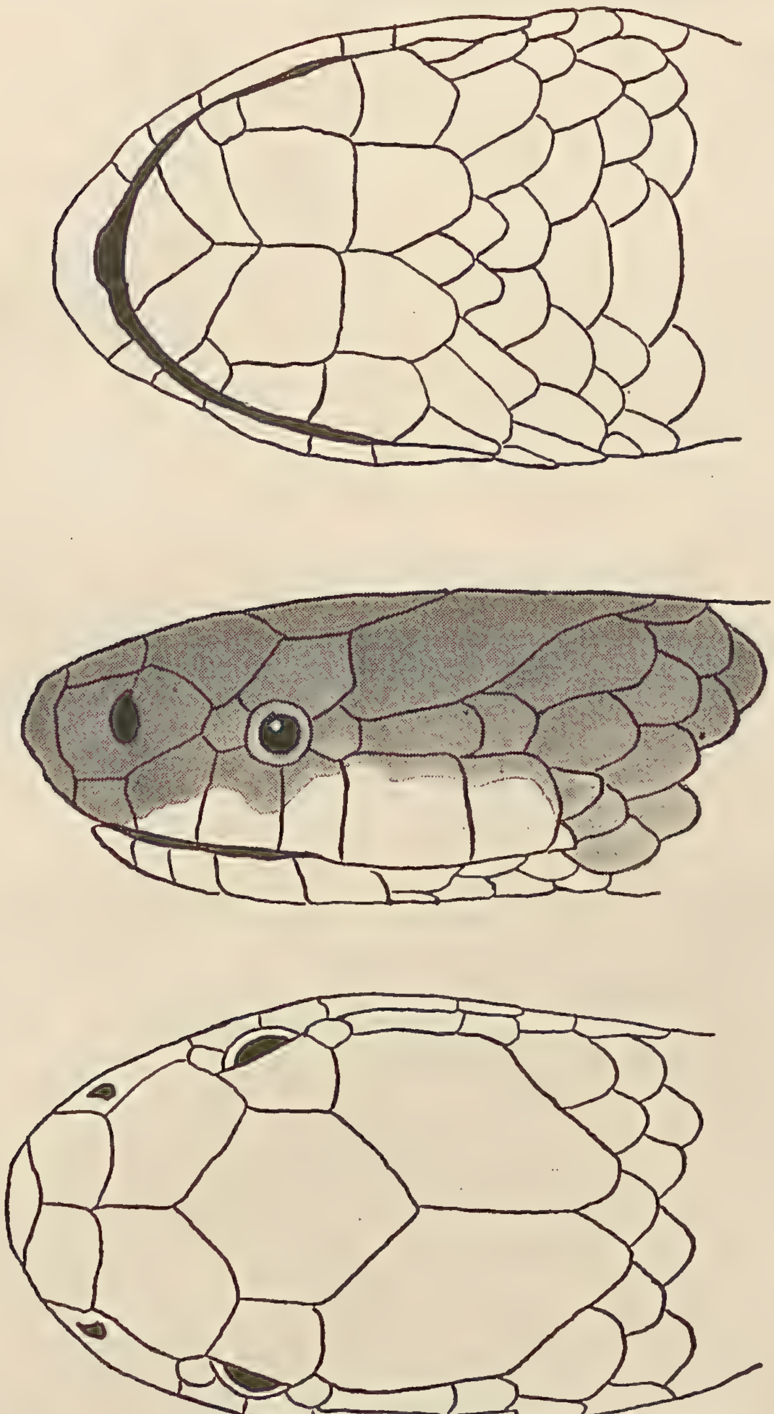
Dorsal colour "deep slaty-brown" (Ridgway, L., 69 ' ' ', K), lighter and warmer on the sides of the body where each scale has a paler edge. Head as back but the parietals very slightly paler, giving the effect of a faint V-shaped bar on the crown; a whitish patch on the cheek reaching from the second labial along the lower border of the orbit to well behind the opening of the mouth. Lower parts creamy white, the basal half of each ventral scale barred for the whole of its width with pale, purplish-brown. Subcaudals barred with much colder pale grey

Total length 431mm.; tail 44mm.

Locality, Torokina, Bougainville Island, November 12, 1944.

Type in the National Museum of Victoria, No. D. 7738.

The three specimens are remarkably uniform both in scalation and colour. The head scales are identical and the body counts close.



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Specimen B.

Scales in 15 rows; ventrals 169; subcaudals 33 pairs.
Total length 466mm.; tail 49mm.

Specimen C.

Scales in 15 rows; ventrals 167; subcaudals 31 pairs.
Total length 421mm.; tail 39mm.

The head of this specimen was removed for examination of skull.

Boulenger described three species of *Denisonia* from the Solomons, namely *D. par.* (1), *D. woodfordii* (2), and *D. melanura* (3). Subsequently Kinghorn (3), and later Burt (5) showed that *par* and *melanura* are synonymous, the former name taking priority. There is considerable variation within these species both in scalation and coloration, but the present specimens are quite distinct. Mr. Clarke notes that he saw numbers of this snake, and that the specimens secured are of average size and are full grown.

The new species is smaller than *par* or *woodfordii*; it has a a single postocular; it has an undivided nasal; it has fewer subcaudal scales. It further differs from *par* in having paired subcaudals, and from *woodfordii* in being darker and more uniform in colour.

References.

(1) Boulenger G. A., Pro. Zoo. Soc. Lond., p. 210, 1884.
(2) Boulenger G. A., Pro. Zoo. Soc. Lond., p. 89, 1888.
(3) Boulenger, G. A., Pro. Zoo. Soc. Lond., p. 88, 1888.
(4) Kinghorn, J. R., Rec. Aust. Mus., XVI, p. 148, 1928.
(5) Burt, C. E., Bull. Amer. Mus. Nat. Hist., LXIII, p. 568, 1932.

MUD ISLANDS, PORT PHILLIP BAY

Their Geology, Botany and Entomology.

Fig. 1.

The group of islands in Port Phillip Bay known as Mud Islands was discovered in 1802, but although only 30 miles from Melbourne it is seldom visited. From time to time men have been employed there digging guano, others have interested themselves in oyster culture, they have been visited by fishermen and by bird lovers studying bird migration, and a few of the more obvious facts relating to the group have been recorded, but no systematic examination of these islands has hitherto been attempted. In November, 1945, 143 years after its discovery, a party of scientists organized by the National Museum of Victoria, went there to investigate the group in relation to their several spheres of activity, R. A. Keble to investigate its geological history, S. R. Mitchell, to ascertain whether there were any traces of a former native habitation, J. H. Willis to investigate its flora, and A. N. Burns, its insect life.

The investigation was of peculiar importance as it was considered that the islands are of recent origin—according to Keble, at the most little more than 3,500 years old—and that they would furnish the material for an interesting ecological survey.

HISTORY AND GEOLOGY OF MUD ISLANDS.

By R. A. Keble, Palaeontologist, National Museum of Victoria.

The group of islands was first sighted on Monday, February 15, 1802, by Acting-Lieut. John Murray when he was working along the south shore of Port King, afterwards renamed Port Phillip by Governor King, to his first anchorage near Point King. He recorded in his log (Lee, 1915).

> . . . to the N.E. by N., about 5 miles from the south shore lies a cluster of small rocky islands and all round them a shoal of sand; plenty of swans and pelicans were found on them when the boat was down, from which I named them Swan Isles . . At half-past 3 p.m. we got to anchor in a sandy cove in 7 fathoms of water, bottom fine sand—Swan Islands bearing N.E. by N. distance 5 miles, a bold rocky point which I named Point Paterson E.S.E. 1½ miles, a long sandy point named Point Palmer west, 1½ miles, and the nearest point of the shore S.W. ½ of a mile distant.

Murray's description of the group as a "cluster of small rocky islands" was an impression gained, doubtless, from a distance,

through binoculars—the rocks at the guano deposit being probably visible to him. One approaching the islands sees, from a long way off, numerous swans and pelicans on the beaches.

Other extracts from the log are:

Wednesday, February 27 . . . In the afternoon the boat went to Swan Isles and caught three live swans of a large size . . . . Saturday, February 17 . . . . Sent Mr. Bowen and Mr. Brabyn in the gig to get the latitude of the north end of Swan Isles and at noon I got the latitude of a point about 7 miles North and South of them from which a base line was got for the survey of the harbour.

The course Murray took when he charted the south-east portion of Port Phillip is shown on his chart made in 1802. It passes Swan Isles a short distance from the group which he shows as consisting of three long and narrow islands, the largest one to the north-west. Obviously Murray's survey party did not actually survey the group.

Charles Grimes, Acting Surveyor General of New South Wales, when he surveyed Port Phillip in January 1803, did not land on the group; he appears to have copied his outlines of them from Murray's chart.

The Rev. Robert Knopwood, who kept a diary during Collins's settlement at Sullivan's Bay near Sorrento, referred to the group as Signet Island. His entry for Tuesday, October 11, 1803, is as follows:

The same party Lieut. Nicholas Pateshall, Purser Edward White and self went on the shore of the island in the middle of the Bay, now called Signet Island, where we see a great number of black swans. I was the first that killed one on the island. We kill 3, and caught many alive, and caught many pelicans, and some sea birds.

The landing was made two days after the expedition arrived at Sullivan's Bay.

Lieut. J. R. Tuckey of Collins's Expedition who surveyed Port Phillip in H.M.S. *Calcutta* in 1804, sketched in four islands; he does not appear to have landed.

The first actual survey was made in 1836 by Lieut. T. M. Symonds and Lieut. H. R. Henry of H.M.S. *Rattlesnake* which afterwards figured prominently in the survey of northern Australian waters, with John Macgillivray and T. H. Huxley as naturalists. Symonds and Henry were the first to refer to the group as Mud Islands, and the channels to the east and west respectively as Pinnace Channel and Symonds' Channel. In 1842 Commander J. C. Wickham and Captain Stokes in H.M.S. *Beagle,* the 10-ton brig so closely associated with the wanderings of Charles Darwin, extended Symonds and Henry's survey, and in 1856 it was further extended by C. J. Polkinghorne. On this

small scale chart, three islands are shown in their true positions; their outlines do not appear to differ from the chart published later in 1859-60 (Fig. 1) surveyed by Commander M. G. H. W. Ross assisted by Messrs. Turton, Sturgess and Deck and corrected up to 1863.

This last chart is the first to give a large scale outline of the group—the natural scale is $\frac{1}{24,400}$—and is referred to here as Ross's chart.

In 1864, Commander Henry L. Cox, assisted by Thos. Bouchier, J. G. Boulton and P. H. McHugh, made the chart of Port Phillip at present in use, and the basis of all subsequent corrections and extensions. The natural scale is $\frac{1}{73,000}$. Cox appears largely to have accepted Ross's survey for Mud Islands.

Physical Features.

The outline of Mud Islands as delimitated by the Coast Survey in 1946 and on Ross's chart of 1859-60 is shown in Fig. 1. It will be seen that while at some places there is agreement, at others there is considerable variation. The question arises, then, as to what is to be inferred from these variations—whether they are due to inaccurate charting or progradation and encroachment during the last 80 years. Considering the difficulties in charting the islands and the changes now in progress in Port Phillip, the variations are probably attributable to both, and for convenience of reference, Mud Islands is assumed to consist of four main islands, none of which are named on the charts, but are known or referred to here as Western Island (69 acres), Middle Island (54 acres), Boatswain's Island (98 acres), and Eastern Island. Besides these there are some low banks, one of which, that between the southern extremity of Western Island and Boatswain's Island, is referred to as Low Bank (11 acres) (Fig. 1.)

The islands are situated near the centre of the Great Sand (Murray's "shoal of sand") trending N.E.; the Great Sand is a little more than 5 miles long by 2·3 miles wide, and outside the group is covered by from 1 to 7 feet of water. The depth increases abruptly to the north-west as one approaches Symonds' Channel which is from 20 feet to 55 feet deep; to the south-west is South Channel with 42 feet of water, and on the north east the southern portion of the Inner Basin of Port Phillip.

The Mud Islands group has been built up on the Great Sand at the only place inside Port Phillip where consolidated dune-rock is exposed above high water mark; dune-rock is the surface rock of the adjacent Nepean Peninsula to the south and east, and partly of the Bellarine Peninsula to the south-west. In the Mud

Islands group, it outcrops at the south-east end of Boatswain's Island, the north end of Western Island, and probably, before it was covered by sand, was exposed at other places. It is known

FIG. 1. MAP OF MUD ISLANDS
Scale: 6 inches to nautical mile.
Coast Survey, 1946
Ross' Chart, 1859-60

from bores put down on the shoals in the southern portion of the bay (Keble, 1946) that dune-rock underlies all the shoals, sands and channels south of a line from St. Leonards to Rosebud. In configuration the group exhibits an atoll-like form—a circlet of

curvate islands enclosing a relatively large tidal lagoon—the Inner Lagoon—under a foot deep; this opens to the south-west into a smaller lagoon, the Outer Lagoon, which has a wide opening to the south. This wide opening is being rapidly filled with sediment, the Low Bank being formed across it. The bottom of the lagoons is sandy mud. The islands, except near their outer fringes, have a fairly level surface, about 5 feet above low water mark, of sandy mud similar to the bottom of the lagoons. Along the outer (western) shore of Western Island, sand-dunes are now being piled up and have reached a height of about 12 feet near the northern and southern ends of that island. All the islands support a low, thick scrub in which there are occasional open spaces where rookeries are found; the largest is on the Middle Island and Boatswain's Island.

Between the eastern island and Middle Island, and flowing over the south-east portion of the Inner Lagoon, Ross shows a waterway with an outlet between the southern extremity of Eastern Island and the south-eastern extremity of Boatswain's Island.

Development of the Mud Islands Group.

In a previous contribution (Keble, 1946), it has been pointed out that the so-called channels through the shoals in the southern portion of Port Phillip Bay could more accurately be called tideways, formed by the outgoing tidal stream of the Inner Basin of Port Phillip finding an outlet into King Bay or Bass Strait, and the incoming tidal stream through The Heads finding its way into the Inner Basin.

The Great Sand has been prograded to the north-east and south-west from a dune rock platform, portions of which are exposed at the south-east end of Boatswain's Island and the northern end of Western Island. This sand has been shaped, and the Mud Islands group given its atoll-like configuration, in the first instance by both the incoming and outgoing tidal streams. The main incoming tidal stream comes through the Heads and along the South Channel, finding its way through Pinnace Channel and the channels east of it into the Inner Basin; it also sets to a lesser extent through Symonds' Channel. The outgoing tidal stream coming from the Inner Basin flows over the banks as well as along the channels.

Age of Mud Islands.

There is evidence around the shores of Port Phillip of the world-wide raised beach, 15 to 20 feet above sea-level, but it is

complicated along the northern shore of the Nepean Peninsula by tectonic movements. Hills (1940) draws attention to the shell-beds up to 5 or 6 feet above ordinary high sea-level between Sullivan's Bay near Sorrento and "The Rocks" at Dromana. He points out that "The gradual fall in elevation of the raised beaches towards The Rocks indicates that their emergence was caused, at least in part, by tectonic movements." If the raised beaches referred to were formed at the Postglacial Optimum, these tectonic movements have occurred since then. The Post-glacial Optimum is estimated to have occurred about 4,000 years ago (*cf.* Brooks, 1922), or, as suggested by the solar radiation curve (*cf.* Zeuner, 1945), about 10,000 years ago. Assuming Mud Islands to have remained static, with a progressive fall of sea-level based on the shorter estimate, they were uncovered between 1,000 and 1,500 years ago, but on the longer period between 2,500 and 3,500 years ago. If the tectonic movements evident on the north shore of the Nepean Peninsula extended to Mud Islands, an upward movement would tend to increase slightly these estimates and a downward movement to decrease them.

The author of this paper has stated elsewhere (Keble, 1946) that the Port Phillip Sunkland on which the Mud Islands group is situated is oscillating, but subsidence is much in excess of uplift.

Some Features of The Mud Islands Group

The sandy mud of the generally level surface of the islands and forming the bottom of the lagoons, suggests a former sea bottom not unlike that of the deeper portions of the Inner Basin. The section at the guano rocks gives some idea of the geological history of the islands.

a. Dune sand accumulating at present and contemporaneous with the unconsolidated dunes at Sullivan's Bay.
b. Guano.
c. Sandy mud which has been partly built up into the dunes (a)
d. Shell limestone, loosely cemented Recent shells predominating.
e. Soft limestone with Recent shells. The limestone layers dip southwards.
f. Pleistocene dune rock comparable with the dune rock at Sullivan's Bay and elsewhere on the Nepean Peninsula and also at Queenscliff.

The guano has been completely removed but there is no doubt as to where its position was in the section. The workings suggest that it was not extensive and a foot or two thick. MacIvor (1879) comments on it as follows: "Flat (or Mud) Island Guano.—This, a Victorian guano, found upon a small island in Hobson's (*sic*) Bay . . . is poor in fertilising constituents, and therefore unsuited

for treatment with sulphuric acid . . . . The following average analysis will show its composition in 100 parts.

Moisture	6·12
Organic matter	23·64
Sand	44·82
Phosphate of lime	20·62
Carbonate of lime	3·31
Other substances	1·49
	100·00.

The organic matter is non-nitrogenous consisting chiefly of vegetable *debris.*"

It has been mentioned here that on Ross's survey a waterway (Fig. 1) is shown draining the tidal flat that formerly existed between Middle Island and Eastern Island; this waterway was joined by a short tributary from the north-west before it entered the open water of Port Phillip Bay immediately north of the guano deposit. On Cox's 1864 chart two other waterways are shown on the north-east side of Boatswain's Island and another was found on the eastern shore of Western Island. An examination of these shows that they are actually tideways. At high tide small basins behind the shore line are filled and as the tide is falling, this water in the basins finds an outlet into the Inner or Outer Lagoons by the tideways that have been suggestively indicated as creeks on the charts; when the tide is rising the water flows back through the tideways from the Lagoons into the small basins. This disposes of the possibility of any of these so-marked creeks being portions of a stream system that drained the surface during the glacial stage when it was dry land. Incidentally, it may be mentioned that on the Nepean Peninsula no streams have been formed on the dune rock and sand which are too porous to hold up surface water; exactly the same conditions are found on Mud Islands.

Conclusions.

The Mud Islands group has been formed by the incoming and outgoing tidal streams behind a dune rock platform, portions of which are exposed above high water mark on the islands.

The islands are not more than 3,500 years old—all vegetation and insect life found on them has appeared there within that period.

That no evidence of the former occupation by the aborigines was found is somewhat surprising in view of the fact that bird rookeries exist. The tangled vegetation leaves few open spaces

and the nature of the surface makes the search for evidence difficult and inconclusive.

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FLORA OF THE MUD ISLANDS, PORT PHILLIP BAY.

By James H. Willis, B.Sc., National Herbarium, South Yarra.

Introduction.

Although the Mud Islands were visited as early as 1803, no one seems to have made any record of the flora until Mr. A. G. Campbell paid a visit on December 27, 1906. Mr. Campbell's list of species was published by A. H. E. Mattingley in the *Victorian Naturalist* XXIV, 12 (May, 1907); it included 20 indigenous plants and 3 naturalized aliens, but no cryptogams. Mr. Mattingley mentions two other plants, viz. *Halophila ovalis* and *Mesembryanthemum aequilaterale,* not listed by Campbell.

By courtesy of the Director, National Museum, Melbourne, the writer was enabled to visit this area on November 30, 1945. Only four hours were spent ashore; but in that time he walked completely around the island group, at the same time traversing most of some 200 acres that remain permanently above high tide level. The vascular flora was increased to 30 native and 10 introduced plants, and, although ten of Campbell and Mattingley's recordings were not observed on this occasion (these are indicated by smaller type in the catalogue that follows), 9 indigenous flowering plants, 7 alien weeds, 9 lichens and 5 mosses were added to their list.

Principal Plant Communities

Mud Islands vegetation displays no feature of unusual interest and is, as might be expected, almost identical with that of the neighbouring coastline—e.g. Swan Island, Queenscliff, just over

five miles away to the west. Four distinct plant communities are recognizable and will now be discussed briefly:

1. *Sand Dune.*

The long narrow Western Island consists of blown sand which, on the northern and southern extremities, is piled into small but stable dunes (to 12 feet high) supporting the only arboreal growth in the area. Old be-lichened trees of *Leucopogon parviflorus* ("Coast Beard-heath") at the northern tip form a tiny unmixed woodland, some 8 or 9 feet tall—apparently the climax community on dune sand. Seven different lichens and three mosses were found on the trunks and branches of these venerable trees, beneath which is an accumulation of leafy litter. The south-western point not only supports a group of *Leucopogon* trees (fewer than at the north end) but also the only occurrence (now) of *Acacia sophorae* ("Coast Wattle") in the islands.

Erect wiry *Scirpus nodosus* ("Knotted Club-rush") and herbaceous annual *Anagallis arvensis* (the introduced "Scarlet Pimpernel") are conspicuous over much of this sand formation, also such pygmy ephemerals as *Sagina apetala, Polycarpon tetraphyllum, Tortella calycina* and *Ceratodon purpureus* (the last two being mosses). *Scirpus nodosus* is an effective sand-binder and has doubtless contributed to the stabilization of the dunes.

The pioneer strand grass *Spinifex hirsutus* was not noted anywhere here—a singular fact, as it is so abundant in many parts of Port Phillip and outside the Heads, wherever cliffs give place to a low sandy shoreline. *Tetragonia expansa, Mesembryanthemum aequilaterale,* and *Cakile maritima* are succulent species mentioned in Mr. Mattingley's account as examples of the sand dune vegetation; but I did not see any of these edible plants in 1945 and suggest that rabbits may have been responsible for their disappearance.

There is evidence of some encroachment by the sea upon the northernmost dune and its *Leucopogon* woodland, for dead trees with bared roots are to be seen standing in the water at some distance from the present dune face. It is most probable that such erosion has exterminated at least three shrub species: the dune composites *Olearia axillaris, Helichrysum cinereum,* and *Calocephalus Brownii* were recorded for the north-west on Campbell's 1906 list, but I failed to find them after a careful search.

2. *Salt Marsh*

The low southern Boatswain's Island, "leg of mutton" shaped and surrounded by shallow waters of the central lagoon, is appar-

ently the most stable part of the region; its outline and area have not changed appreciably since 1860 (*q.v.* Admiralty chart). Except for a few patches of blown sand facing the south-western dunes across the lagoon, this area consists wholly of black mud which is densely covered with *Arthrocnemum arbusculum* ("Shrubby Glasswort," to 5 ft.)—the dominant species—in various mixture with *Suaeda maritima, Atriplex paludosa, Salicornia australis, Frankenia pauciflora* and *Samolus repens,* the last being abundant throughout. The salt marsh presents a rather drab and monotonous aspect; the waterlogged soil, supporting such a thick mantle of chenopodiaceous and other small shrubs, is rich in organic matter. Again, in this community one misses such characteristic halophytes as *Disphyma australis, Pratia platycalyx* and *Selliera radicans* which are common plants of the salt marsh association in other parts of Port Phillip and in Westernport Bay.

The ground is honeycombed with Storm Petrel burrows, where patches of the marsh growth have been covered by drift sand, and in these situations two weeds have taken possession: *Anagallis arvensis* ("Scarlet Pimpernel") forms an almost continuous carpet, while *Cucumis myriocarpus* ("Gooseberry Cucumber") is also abundant and perhaps of more recent introduction—Campbell did not observe it in 1906. The sole living, and very aged, tree of *Myoporum insulare* ("Boobialla") is to be found on this, Boatswain's Island, near a sandy rise; sprawling shrubs of *Atriplex cinerea* ("Coast Saltbush") also favour such higher parts of the marsh, their branches often encrusted with the vivid orange lichen *Teloschistes parietinus.*

3. *Raised Shell Beds.*

Practically the whole eastern section of the group consists of accumulated shells or shell-grit with a very sparse plant cover. Isolated clumps of *Atriplex cinerea* and *A. patula* (introduced annual) comprise almost the entire flora in the north-east, i.e. beyond Middle Island; but at the south-eastern extremity, several other annuals appear among the two saltbushes, viz., *Pholiurus incurvus, Melilotus indica* and *Sonchus oleraceus.*

It is convenient to class with the shell-beds a few acres of guano (formerly exploited) at the north-east, which carries an entirely alien flora—doubtless the result of man's interference. The dominant weeds here are *Urtica urens* ("Common Nettle"—very abundant) and *Anagallis arvensis. Cerastium glomeratum* and the two grasses *Poa annua* and *Vulpia bromoides* occur in a very

depauperate condition, while the rock-like guano itself is covered by the crustaceous lichens *Lecanora umbrina* and *Candelariella vitellina.*

4. *Shallow Water.*

In the lagoon and shallows, especially at the northern end of the group, is an association of aquatic phanerogams consisting for the most part of *one* species, *Zostera muelleri* ("Dwarf Grass-wrack")—the food of water birds. *Z. tasmanica* also occurs at the north and, apparently, *Halophila ovalis* in deeper water, though I did not see it.

General Notes

In addition to the four well-defined communities just mentioned, one can distinguish certain transitional elements along their respective borders—e.g. *Stipa teretifolia* of the dunes occurs sparingly on raised shell beds, while *Atriplex cinerea* of the latter formation enters the dunes; *Suaeda maritima* and *Salicornia Blackiana* migrate from their typical marsh habitat out on to the shelly beds, the latter species appearing to favour drier ground than its congener *Salicornia australis*: the three weeds *Urtica, Anagallis* and *Cucumis,* while more abundant on guano, also extend out into the dunes. It would be interesting to tabulate the occurrences of all these species again after another period of, say, 40 years and note any changes in local distribution. Indeed, the Mud Islands, so circumscribed and relatively free from interference, would form an admirable subject for a detailed ecological survey.

Chenopodiaceae is by far the largest natural assemblage, both in species (8) and individuals; this family and the *Gramineae* (5 species) together account for 43 per cent of the islands' original flora (30 spp.). The number of indigenous species per genus is 1·1, and of species per family 2·1. (N.B., Dr. R. T. Patton also obtained the former figure in his studies on Salt Marsh flora—*q.v. Proc. Royal Soc. Vict.* LVI, p. 134, 1942). Systematically, the naturalized alien plants now constitute exactly a quarter of the flora, but none of the ten species seems to be aggressive or likely to threaten the existence of any plants native to the area.

Extensive sand banks with very shallow water are not conducive to a rich algal flora and, indeed, the shores of Mud Islands seem deficient in marine algæ. The attractive calcareous *Acetabularia peniculus* was noted (washed ashore on the backs of shells), also several *Caulerpa* species; but no attempt was made to catalogue any marine algæ for this small area.

Systematic Arrangement.

(Alien plants indicated by an asterisk*; species not noted in 1945, by smaller type.)

FLOWERING PLANTS.

POTAMOGETONACEAE
Zostera
Muelleri Irmisch.
(Syn. *Z. nana* Roth.)—Aquatic.
tasmanica Martens — Aquatic. (north).

HYDROCHARITACEAE
Halophila
ovalis (R.Br.) Hk.f.—Aquatic.

GRAMINEAE
Distichlis
distichophylla (Labill.) Fassett. (not *D. spicata* (L) Greene)—S.W. area.
Poa
**annua* L—Guano (depaup.).
poaeformis (Labill.) Druce (Syn. *P. Billardieri* Hk.f.)—S.W. area.
**Vulpia*
bromoides (L) S. F. Gray—Dune, Guano (depaup.).
Stipa
teretifolia Steud.—Dune Shell.
Danthonia
penicillata (Labill.) F. v. M. (? in bud only)—Dune.
Pholiurus
incurvus (L) Schlnx et Thell.—Shell (S.E.).

CYPERACEAE
Scirpus
nodosus Rottb.—Dune (common in S.W.)

URTICACEAE
Urtica
**Urens L.*—Dune, Guano (abundant).

CHENOPODIACEAE
Rhagodia
baccata (Labill.) Moq.—Dune, Marsh (depaup.)
Atriplex
Cinerea Pair—Shell (abundant) Dune, Marsh.
paludosa R.Br.—Marsh.
**patula* L.—Shell (probably the "Chenopodium" of Campbell).
Salsola Kali L.

SUAEDA
Maritima Dum.—Marsh, Shell.

SALICORNIA
australis Banks et Sol.—Marsh (abundant).
Blackiana Ulbrich—Marsh (to drier ground).

ARTHROCNEMUM
arbusculum (R.Br.) Moq.—Marsh (dominant).

AIZOACEAE.
Tetragonia expansa Murr.
Carpobrotus aequilaterus (Haw.) N.E.Br.
(*Syn. Mesembryanthemum aequilaterale* Haw.).

CARYOPHYLLACEAE
**Cerastium*
glomeratum Thuill.—Guano (depaup).
Sagina
apetala L.—Dune (ephem.)
Polycarpon
tetraphyllum L.f.—Dune (ephem.)

CRUCIFERAE
Cakile maritima Scop.
var. *edentula* (Hk.) Jord.

LEGUMINOSAE
Acacia
Sophorae R.Br.—Dune (S.W., not "N.W." of Campbell).
**Melilotus*
indica All.—Shell (S.E.).

FRANKENIACEAE
Frankenia
pauciflora DC.—Marsh (common).

EPACRIDACEAE
Leucopogon
parviflorus (Andr.) Lindl.—Dune (dominant).

PRIMULACEAE
**Anagallis*
arvensis L.—Dune, Guano (abundant).
Samolus
repens Pers.—Marsh (abundant)

MYOPORACEAE
Myoporum
insulare R.Br.—Marsh (one tree on sandy rise).

CUCURBITACEAE
**Cucumis*
myriocarpus Naud.—Dune, Guano (common).

COMPOSITAE
Olearia axillaris F. v. M.—(N.W.)
Helichrysum cinereum (Labill.) F. v. M.—(N.W.)
Calocephalus Brownii (Cass.) F. v. M.—(N.W.)

**CARDUUS*
pycnocephalus Jacq.—Dune (Probably the "*C. lanceolatus*" of Campbell).

**SONCHUS.*
oleraceus L.—Shell (S.E.)

CRYPTOGAMS

(excluding Algæ)

Musci
Ceratodon purpureus (L) Brid.—bare sand.
Tortella
calycina (Schwgr.) Dixon—bare sand.
Tortula
papillosa Wils.—on Leucopogon trunks.
Zygodon
minutus C. Müll. et Hampe—on *Leucopogon* trunks.
Bryum
truncorum Brid.—humus under *Leucopogon.*
Lichenes
On trunks and branches of *Leucopogon.*
Parmelia
caperata Ach.
perforata Hook.
Physcia
pulverulenta Nyf.
Ramalina
calicaris Fr.
Ecklonii Mont.
Teloschistes
chrysophthalmus Th.Fr.
parietinus (L.)—also on other wood and rocks.
On Guano rocks:
Lecanora
umbrina Massal.
Candelariella
vitellina Müll-Arg.

INSECTS COLLECTED AT MUD ISLANDS, PORT PHILLIP BAY. November 30, 1945.

By A. N. Burns, B.Sc., F.R.E.S. Entomologist, National Museum of Victoria.

Order ***DERMAPTERA***
Family LABIDURIDAE

Labidura truncata Kirby

Common under shore debris, especially driftwood. Not found amongst vegetation above shore level.

Order ***HEMIPTERA***
Family CYDNIDAE

Acatolectus sp. near *piceus.*

A single specimen found just above the shoreline, among debris.

Order ***COLEOPTERA***

Family CURCULIONIDAE

Leptops Duponti Boisd.

One specimen found on the ground among small bushes. This species is very plentiful along the coast of the Bay, where it is found in association with *Acacia longifolia.*

Order ***HYMENOPTERA***

Family BEMBECIDAE

Bembex furcata Sm.

A small number of specimens captured flying about sandy patches a few feet above high water mark. These wasps capture flies which they carry to their burrows and store to provide food for their larvæ.

Order ***DIPTERA***

Family TABANIDAE

Tabanus bassi Ferg.

Several specimens captured, but not plentiful enough to constitute a nuisance. This species occurs freely in Tasmania, the islands of Bass Strait, and the southern portion of the mainland.

Family THEREVIDAE

Anabarrhynchus maritima Hardy.

Several specimens seen, one taken on the wing. A fairly abundant species on the mainland.

Family MUSCIDAE

Musca domestica L.

Very common everywhere, no doubt breeding in the excreta of birds.

Anastellorhina stygia Fab.

Plentiful, no doubt breeding in excreta, dead young birds, etc.

Order ***LEPIDOPTERA***

Family LYMANTRIIDAE

Acyphas chionitis Turn.

This species is also common on the mainland.

Family NYMPHALIDAE

Pyrameis itea Fab.

This species is also abundant in Tasmania and on the mainland.

Insect life was not plentiful on the Islands, and all species met with occur on the mainland. This is only to be expected on account of their proximity to the latter. Winged insects would have little difficulty in reaching the islands, and a number of apterous ones could be carried there on driftwood and in debris. That many could establish themselves is doubtful, because of the small variety of trees and plants present.

A PRELIMINARY REPORT ON THE BIOLOGY AND ECOLOGY OF THE SNOWY RIVER AREA IN NORTH-EASTERN VICTORIA.

(Plates 11-13).

This report deals with a primary visit to the area, provides a generalized description of the country, and lists the plants and animals collected.

The Snowy River and its tributaries between Buchan and the Victoria-New South Wales border traverse much country which is unpopulated and remains in its virgin state. It is steeply mountainous, consisting of an unbroken series of ranges and valleys which support a varied flora, and which extend northwards towards Mt. Kosciusko in New South Wales. With the exception of the Snowy River itself, no ground survey of the country has ever been made, and it is almost unknown biologically.

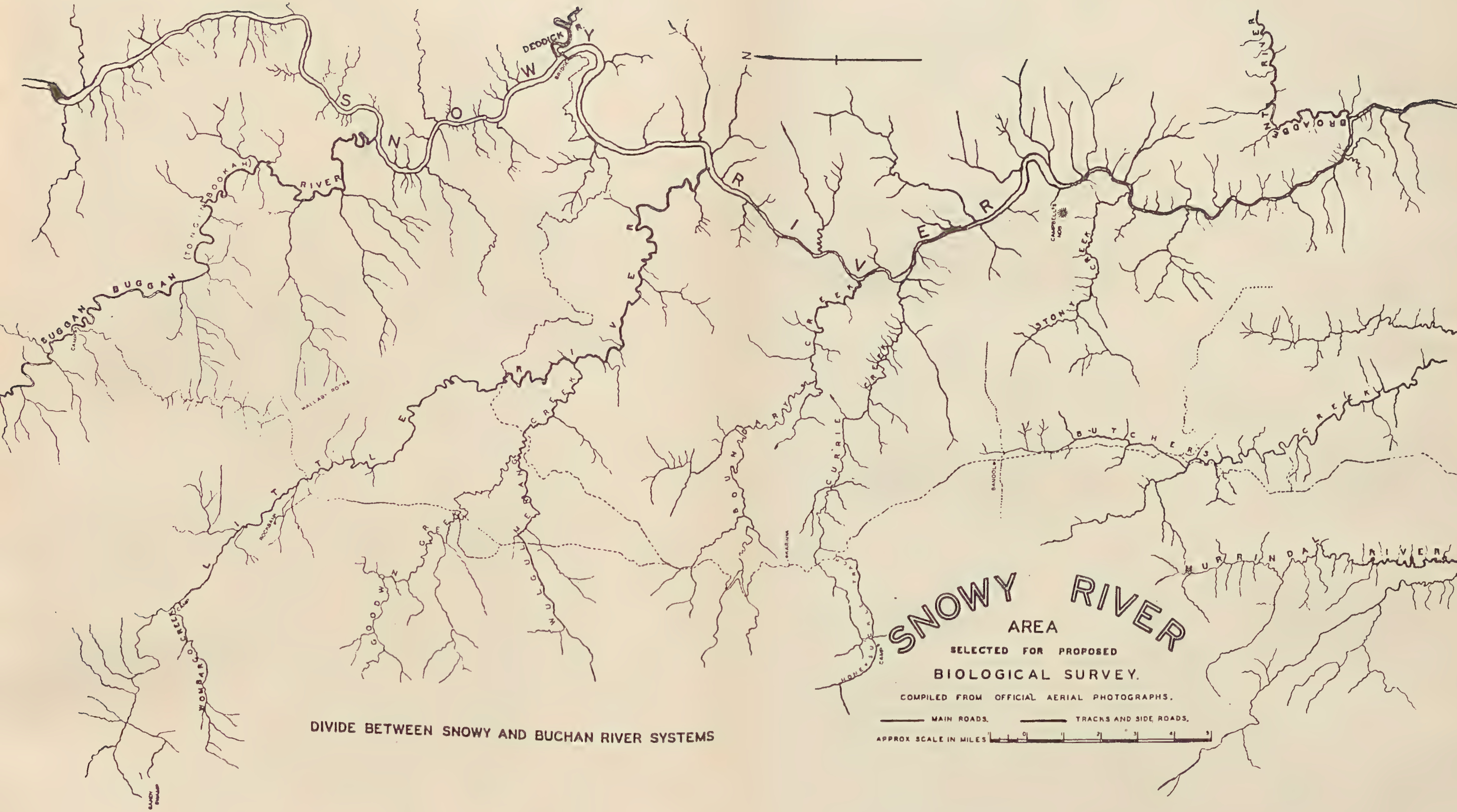
These conditions alone make the area a desirable one for an ecological study, but there is also another consideration. There is a proposal by Governmental bodies to divert the water of the Snowy River for use in the generation of hydro-electric power and for irrigation. This may have some repercussion on the biological balance of the area below the diversion, and could, in the future, form the subject for an interesting comparison.

The above facts outline the reasons for the investigation by the National Museum of Victoria.

Museum personnel on the primary visit consisted of C. W. Brazenor (Mammalogist), J. H. Macpherson (Conchologist), S. G. Whincup (Mineralogist), and R. Boswell (Preparator).

A camp on the Snowy River, planned from the very meagre maps and information available before the trip, proved to be impractical when the area was reached. Headquarters was therefore established near Gelantipy, and two- or three-day excursions were made from there. In this manner the party visited the Snowy River, at Campbell's Nob and at its junction with the Deddick River, the Suggan Buggan River, the Little River and Wombargo Creek, the Murrindal River gorge, and high country between the source of the Buchan River and Wombargo Creek. From observations made during these excursions, the following sketch of the area may be made.

The country rock of the area is mainly Snowy River porphyry. Under this heading is included varied rock types, a number of


SNOWY RIVER
AREA
SELECTED FOR PROPOSED
BIOLOGICAL SURVEY.
COMPILED FROM OFFICIAL AERIAL PHOTOGRAPHS.
MAIN ROADS.
TRACKS AND SIDE ROADS.
APPROX SCALE IN MILES
0
1
2
3
4
5
N
SNOWY RIVER
DEDDICK R.
BROADBENT RIVER
BOOKAH RIVER
(TONGI)
BUGGAN BUGGAN
LITTLE RIVER
BOUNDARY CREEK
CURRIE CREEK
STONY CREEK
BUTCHERS CREEK
MURRINDAL RIVER
WULGULMERANG CREEK
GOODWIN CREEK
WOMBARGO CREEK
DIVIDE BETWEEN SNOWY AND BUCHAN RIVER SYSTEMS

which can be described as volcanic agglomerates whilst others are true quartz porphyries; in places they are many hundreds of feet thick. Underlying this is granite, which outcrops in some areas. There are also exposures of Ordivician, isolated small outcrops of basalt, and, to the south, some limestone. The steep mountainsides hold practically no soil and there is little alluvial deposition in river valleys.

The bare country absorbs little of the rainfall, which averages 30 inches per year, and the run-off causes a very rapid change of river rise and fall which is accentuated at the time of melting snow.

The northern slopes of the mountains are dry and open; the southern slopes are less dry and carry more scrub. In the high country (4,000 to 5,000 feet) there are large areas of Snow Grass (*Poa caespitosa*) and stands of Snow Gum (*Eucalyptus pauciflora*). The northern lower slopes carry White Gums (*Eucalyptus viminalis* and *E. rubida*) and Box (probably *Eucalyptus albeus*), and have little or no ground cover though some areas have a sparse growth of the low-growing Tea Tree (*Leptospermum attenuatum*). The principal tree on the southern slopes is the Woollybutt (*Eucalyptus gigantea*). Still lower in the gullies is a varying amount of scrub including Blanket-leaf (*Bedfordia salicina*), Musk (*Olearia argophylla*), and several species of Tea Tree (*Leptospermum lanigerum, Bæckea Gunniana,* and *Kunzia peduncularis*). In the deeper gully-heads, the scrub thickens to jungle proportions, and besides Blanket-leaf and Musk contains Lilly-pilly (*Eugenia Smithii*), Wire Grass (*Tetrarrhena juncea*) and Lianes including Clematis (*Clematis aristata*) and Supplejack (*Lyonsia straminea*).

Such a short, generalized outline of the country must necessarily leave many gaps, but is intended to present only an overall view which, as specific localities are more intensively worked, may be filled in.

PLANTS COLLECTED

We are indebted to Dr. R. T. Patton, Melbourne University, for the identification of botanical specimens.

Family **GRAMINEAE**

Genus POA

Poa caespitosa G. Forst.

Wombargo Tableland, 5,000 feet.

Family **LILIACEAE**

Genus DIANELLA

Dianella revoluta R.Br.

Wombargo Creek above 3,000 feet.

Family **PROTEACEAE**

Genus LOMATIA

Lomatia longifolia R.Br.

Wombargo Creek above 3,000 feet.

Genus HAKEA

Hakea microcarpa R.Br.

Junction of Little River and Wombargo Creek.

Genus GREVILLEA

Grevillea lanigera A. Cunn.

Junction of Little River and Wombargo Creek.

Family **RANUNCULACEAE**

Genus CLEMATIS

Clematis aristata R.Br.

Wombargo Creek above 3,000 feet.

Family **LEGUMINOSAE**

Genus ACACIA

Acacia diffusa Edwards.

Junction of Little River and Wombargo Creek.

Acacia longifolia Willd.

Snowy River at Campbell's Nob.

Acacia dealbata Link.

Snowy River at Campbell's Nob; Wombargo Creek above 3,000 feet.

Genus PULTENAEA

Pultenaea largiflorens F. v. M.

Junction of Little River and Wombargo Creek.

Family **RUTACEAE**

Genus CORREA

Correa rubra Sm.

Murrindal Gorge, W. Tree.

Family **EUPHORBIACEAE**

Genus EUPHORBIA

Euphorbia Lathyris L.

Snowy River at Campbell's Nob. (Introduced weed).

Genus PHYLLANTHUS.

Phyllanthus Gunnii Hk.

Murrindal Gorge, W. Tree.

Family **MYRTACEAE**

Genus LEPTOSPERMUM

Leptospermum attenuatum Smith.

Junction of Little River and Wombargo Creek; Wombargo Creek above 3,000 feet.

Leptospermum lanigerum Smith

Junction of Little River and Wombargo Creek.

Genus KUNZEA

Kunzea peduncularis F. v. M.

Snowy River at Campbell's Nob.

Genus BAECKEA

Baeckea Gunniana Schauer.

Junction of Little River and Wombargo Creek; Wombargo Creek above 3,000 feet.

Family **ARALIACEAE**

Genus TIEGHEMOPANAX

Tieghemopanax sambucifolius Viguer.

Wombargo Creek above 3,000 feet.

Family **EPACRIDACEAE**

Genus LEUCOPOGON

Leucopogon Hookeri Sond.

Junction of Little River and Wombargo Creek; Wombargo Creek above 3,000 feet.

Family **LABIATAE**

Genus PRUNELLA

Prunella vulgaris L.

Wombargo Creek above 3,000 feet.

Family **SCROPHULARIACEAE**

Genus VERONICA

Veronica perfoliata R.Br.

Junction of Little River and Wombargo Creek.

Veronica Derwentiana Andr.

Wombargo Creek above 3,000 feet.

Family **RUBIACEAE**

Genus COPROSMA

Coprosma hirtella Labill.

Wombargo Creek above 3,000 feet.

Family **COMPOSITAE**

Genus OLEARIA.

Olearia alpicola F. v. M.

Wombargo Creek above 3,000 feet.

GEOLOGY

By Sylvia G. Whincup, M.Sc., Mineralogist.

The area covered by this preliminary survey is a strip of country on the western side of the Snowy River, between Suggan Buggan in the north and W Tree in the south. A description of the geology of this area is included in the excellent reports by Howitt (2) and (4), who spent many months in northern Gippsland, and also by Ferguson (1). It is not felt that very much detailed geology can at present be added to these reports, as it was not possible to make more than a hurried visit to most of the localities mentioned. However some interesting, if somewhat disconnected, observations are recorded.

Description of Area.

Most of the rocks exposed in this area belong to the series known as the Snowy River Porphyries—these consist mainly of volcanic rocks of Lower Devonian age having a total thickness of some 2,000 feet. On the relatively flat-topped plateau between W Tree and Wulgulmerang, the porphyries are covered in places by remnants of Tertiary basalt flows. To the west, the land rises gradually to a ridge running north and south between Mt. Wom-

bargo and Mt. Statham, and extending south towards Buchan, while to the east it drops very steeply to the valley of the Snowy River.

The porphyries are very hard, and their resistance to erosion has resulted in the development of steep rocky gorges along many of the swiftly flowing rivers in the area.

At Suggan Buggan, and along the Snowy River at the junction of the Deddick River and at Campbell's Nob, older granitic rocks are exposed. In these areas, the river valleys open out, becoming relatively broad and flat, and the topography is much less rugged.

The older sedimentary rocks (Ordivician) which underlie the Snowy River Porphyries were not examined during this preliminary survey.

Notes on Rocks Collected

Granitic Rocks.

The rocks exposed at Suggan Buggan, at the junction of the Deddick River and at Campbell's Nob are grey, even-textured, plutonic rocks containing quartz, white felspar, and abundant biotite, with a little hornblende in places. Sections have not yet been cut, but in hand specimens, the rock resembles granodiorite. Microscopic examination of a crushed specimen revealed abundant plagioclase felspar, but the ratio of plagioclase to orthoclase cannot be determined without sectioning. Xenoliths of sedimentary rocks in all stages of assimilation are common at Suggan Buggan and at the Snowy River Bridge.

These grey granitic rocks are older than the overlying Snowy River Porphyries. Evidence for this can be seen in road cuttings above the Suggan Buggan River, where sections have exposed at least one large mass and a few small rounded boulders of the granitic rock embedded in the porphyries. On the western bank of the Snowy River, just north of Campbell's Nob, similar boulders can be seen embedded in fine-grained porphyry—(Plate 13, lower.

Snowy River Porphyries

This series includes many types of rock, most of which appear to be of volcanic origin. They have been described in detail by Howitt (2), and only specimens collected on this survey are described here.

(a) Quartz Porphyry.—Massive quartz porphyry occurs south of Currie Creek, approximately two miles west of the Gelantipy-Wulgulmerang Road. This rock is very uniform, and con-

tains phenocrysts of quartz and felspar, up to ½ inch long, set in a salmon-pink ground mass. Xenoliths, if present, are very rare. Many large boulders show evidence of spheroidal weathering, similar to granite. The rock decomposes to a poor gritty soil, which does not support a dense vegetation on the hillsides. The western limits of this quartz porphyry are not known; a track south of Currie Creek was followed westwards for at least one mile without any apparent change in the nature of the rock.

This outcrop is probably similar to quartz porphyry described by Howitt from the Cobboras, Mt. Wombargo and Mt. Statham; and, as he suggests, these masses are probably "the denuded stumps of volcanoes" which lie on an old meridional fissure extending from the Cobboras to Buchan.

(b) Volcanic Rocks.—South of Currie Creek, approximately 1½ miles west of the road, the quartz porphyry described above is in contact with a fine-grained volcanic rock, containing phenocrysts of quartz in a fine-grained ground mass which, although altered, shows a well defined flow structure (Plate 12, upper). Angular xenoliths are common, and in places the rock shows evidence of secondary silicification.

To the east of this locality, all the Snowy River porphyries so far examined consist of volcanic rocks, and include tuff beds and great masses of agglomerate. The eruptions producing this great thickness of material appear to have been of the explosive type, rather than quiet eruptions producing vast flows of lava.

Huge masses of agglomerate stand out above the surrounding vegetation at a locality known as Bare Rock, situated south of Boundary Creek in the parish of Wulgulmerang East. These masses are composed mainly of boulders of quartz porphyry which stand out in relief on the weathered surface of the rocks. Many of the boulders appear to have been rounded before being incorporated in the agglomerate. Masses of similar agglomerate are exposed on the high rugged cliffs, where the colony of rock wallabies was located above the Suggan Buggan River.

In all cuttings on the road down to the Suggan Buggan River, the rock appears to be very uniform, and contains phenocrysts of quartz and pink felspar with abundant fragments of sedimentary rock set in a grey or pinkish ground mass. This rock is very hard and massive, and was responsible for considerable trouble during road building operations. The same type of rock occurs north of Little River, near its junction with Wombargo Creek, and also along the Forest Commission Road which is being cut from the main road just north of Boundary Creek westwards to a peak known as Seldom Seen.

"Porphyry" showing flow structure—south of Currie Creek.

Volcanic Pisolites—Gelantipy-Wulgulmerang Road near Boundary Creek.

Tuff Beds—Volcanic Pisolites

Volcanic tuff is exposed in cuttings along the Gelantipy-Wulgulmerang Road near Boundary Creek, where it forms compact fine-grained rocks of pink or yellowish colour. One bed of reddish coloured tuff exposed south of Boundary Creek contains small spherical pellets of hardened ash set in a cement of the same material. (Plate 12, lower). These pisolites vary in size from one-sixth inch to one-half inch in diameter, and appear to have been slightly flattened by the weight of the overlying strata. Joints in the tuff bed pass through some of the pellets. In section, these pellets have a concentric structure, and it is suggested that they have been formed by trickles of water, or by wind rolling some nucleus over a surface of soft volcanic mud. Their appearance does not suggest that they were formed in the atmosphere and fell as mud balls as was recorded at Vesuvius by Perret (5). The name Accretionary Lapilli in preference to Volcanic Pisolites has been suggested by Wentworth and Williams (6).

Middle Devonian Limestones

The Buchan limestones which overlie the porphyries further south were not examined during this survey.

Sub-Basaltic Deposits

(a) Carbonaceous Mudstone.—Boulders of black carbonaceous mudstone containing fragmentary plant remains were found in Butcher's Creek, about one mile above its junction with Back Creek. Time did not permit a search for the outcrop from which the boulders were derived, but in view of the soft crumbly nature of the mudstone, it cannot be more than a few chains distant. Quartz grains from 1-2mm. are common in the mudstone, and two almost perfect bi-pyramidal crystals were found in one small specimen. The plant remains, mainly stems and woody tissue, have not yet been determined.

This bed is probably of small local extent, and may be of the same age as a sub-basaltic plant bed described by Howitt (3) from a deep lead at Mayford on the Upper Dargo River, and identified by McCoy as Miocene.

(b) Quartzite and Opal.—Quartzite occurs directly beneath the basalt a quarter of a mile north of Currie Creek, and also further south between Gelantipy and W Tree. Small patches of common opal and wood opal occur at W Tree also beneath the basalt. Silicification of sediments forming the quartzite and opal was probably caused by solutions derived from the basalt at the time of its eruption.

The foregoing is a very incomplete record of the rocks occurring in the area, but it may serve a useful purpose in giving some indication of the great amount of work yet to be done there.

I am indebted to Messrs. G. Baker and A. Gaskin of the Geology School, Melbourne University, for helpful discussion, and to Messrs. A. Hodge and C. Sykes, of Gelantipy, for assistance in the field.

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6. Wentworth, C. K. and Williams, H. Bulletin of the National Research Council No. 89, Pub. by the National Academy of Science, Washington D.C., p. 37, 1932.

MAMMALS

By C. W. Brazenor, Mammalogist.

Order ***MARSUPIALIA***

Sub-order ***Diprotodontia***

Family MACROPODIDAE

Genus PETROGALE Gray, 1837

Petrogale penicillata Griffith, Smith and Pidgeon, 1827.

Petrogale penicillata Griffith, Smith and Pidgeon, Anim. King, (Cuvier), Mamm., V, p. 204, 1827.

Rock Wallabies were at one time very numerous throughout the Snowy River area, but unrestricted hunting, a disease epidemic, or possibly a combination of the two, drastically reduced their numbers in the early part of the present century. For more than 30 years, no Victorian specimen has been recorded at the National Museum, and the species has been considered extinct in that State.

A small colony was found on a mountainside at Suggan Buggan. It was estimated that it consisted of 10 to 12 individuals which, from observation, appeared to lead a nomadic existence over a little more than a mile of rocky outcrop. The site is un-

disturbed, and the animal's only natural enemy is the dingo (feral dog) which is numerous in the district. One of the larger wallabies was collected for examination, and proved to be a female with a pouch embryo. Its coloration is typical in all details.

1 ♀, Locality—Suggan Buggan, H. and B. 521mm., T. 533mm., H.F. 162mm, E. 43·5mm.; Mus. No. C 958.

Family **PHALANGERIDAE**

Genus TRICHOSURUS Less., 1828

Trichosurus caninus (Ogilby), 1835

Phalangista caninus Ogilby, Pro. Zoo. Soc. Lond., p. 191, 1835.

The species is still common at high elevations in Woollybut (*Eucalyptus gigantea*) country.

1 ♂, Locality—The Cobras. Mus. No. C 978.

Trichosurus vulpecula (Kerr), 1792

Didelphis vulpecula Kerr, Linn. Anim. King., p. 198, 1792.

Common at lower elevations in White and Blue Gums.

1 ♂, Locality—Nr. Gelantipy. Mus. No. C. 965.

Genus PSEUDOCHIRUS Ogilby, 1836

Pseudochirus laniginosa (Gould), 1858

Phalangista laniginosa Gould, Mamm. Aust., I, pl. XX, 1858.

The specimens collected are a clear grey on the dorsal surface, with but a faint suffusion of ochraceous—tawny on the limbs. Ventral surface pure white. They are prominent when placed among a series of typically warm-coloured Victorian ringtails. The future acquisition of a larger series will prove whether the cool grey colour is a racial character in this high altitude.

1 ♂, 1 ♀. Locality—Wombargo Creek at 3,000 feet. Mus. No. C 963 and C 964.

Genus SCHOINOBATES Lesson, 1842

Schoinobates volans (Kerr), 1792.

Didelphis volans Kerr, Anim. King. (Linne), p. 199, 1792.

1 ♀. Locality—W Tree. Mus. No. C 980.

Genus PETAURUS Shaw and Nodder, 1791

Petaurus australis Shaw and Nodder, 1791

Petaurus australis Shaw and Nodder, Nat. Misc. II, pl. LX, 1791.

2 ♀ ♀. Locality—Honeysuckle Track, Nr. Gelantipy. Mus. No. C 961 and C 962.

Petaurus breviceps Waterhouse, 1839

Petaurus breviceps Waterhouse, Pro. Zoo. Soc. Lond., p. 152, 1839.

1. Locality—Nr. Gelantipy. Mus. No. C 959.

1. Locality—Suggan Buggan River. Mus. No. C 960.

Sub-order ***Polyprotodontia***

Family **DASYURIDAE**

Genus ANTECHINUS Macleay, 1841

Antechinus flavipes (Waterhouse), 1838.

Phascogale flavipes Waterhouse, Pro. Zoo. Soc. Lond., p. 75, 1838.

1 ♂. Locality—Honeysuckle Track, Nr. Gelantipy. Mus. No. C 968.

1 ♂. Locality—W Tree, Mus. No. C 969.

Order ***PLACENTALIA***

Sub-order ***Rodentia***

Family **MURIDAE**

Genus RATTUS Fischer, 1803.

Rattus assimilis (Gould), 1858

Mus assimilis Gould, Pro. Zoo. Soc. Lond., p. 241, 1858.

5 ♀, 2 ♂. Locality—Junction Little River and Wombargo Creek. Mus. Nos. C 967 and C 970-5.

1 ♀. Locality—Snowy River at Campbell's Nob. Mus. No. C 976.

Rattus rattus Linn.

This introduced species was taken with *assimilis* at Snowy River.

1 ♀. Mus. No. C 977.

AMPHIBIANS AND REPTILES

By C. W. Brazenor, Mammalogist.

Order ***AMPHIBIA***

Sub-order ***Salientia***

Family **BUFONIDAE**

Genus PSEUDOPHRYNE Fitzing., 1843.

Pseudophryne bibronii Gunth., 1858

Pseudophryne bibronii Gunth., Brit. Mus. Cat. Bat. Salien., p. 46, 1858. 2 spec. Locality—Honeysuckle Track nr. Gelantipy. Mus. Nos. D 7703-4.

Family **HYLIDAE**

Genus HYLA Laurenti, 1768.

Hyla lesueurii D. and B., 1868

Hyla lesueurii Dum. and Bibr., Keferst. Arch. f. Naturg., p. 278, 1868. 1 spec. Locality—Honeysuckle Track nr. Gelantipy, Mus. No. D 7705.

Hyla ewingi D. and B., 1841

Hyla ewingi Dum. and Bibr., Erpt. Gen., VIII, p. 597, 1841. 5 spec. Locality—Little River. Mus. Nos. D 7708-12.

Family **CERATOPHRIIDAE**

Genus CRINIA Tschudi, 1838

Crinia signifera Girard, 1853

Crinia signifera Girard, Pro. Acad. Philad., p. 442, 1853. 1 spec. Locality—Little River. Mus. No. D 7707.

Genus LIMNODYNASTES Fitzing., 1943.

Limnodynastes dorsalis (Gray), 1841.

Cystignathus dorsalis Gray, Gray's Trav. N.W. and W. Aust. II., p. 446, 1841. 1 spec. Locality—Little River. Mus. No. D 7706.

Order ***REPTILIA***

Sub-order ***Squamata***

Family **SCINCIDAE**

Genus SPHENOMORPHUS Fitzing., 1843

Sphenomorphus quoyii (D. and B.), 1839

Lygosoma quoyii Dum. and Bibr., Erpt. Gen., V, p. 728, 1839. 10 young specimens found together under a log. Locality—Wombargo Creek (3,000 feet). Mus. Nos. D 7713-22. 5 spec. Locality—Honeysuckle Track, nr. Gelantipy. Mus. Nos. D 7723-27.

Genus LEIOLOPISMA Dum. and Bibr., 1837

Leiolopisma metallica (O'Shaugn.), 1874

Mocoa metallica O'Shaugn., Ann. Mag. Nat. Hist., (4), XIII, p. 299, 1874. 1 spec. Locality—Honeysuckle Track, nr. Gelantipy, Mus. No. D 7728.

Leiolopisma entrecasteauxii (D. and B.), 1839

Lygosoma entrecasteauxii Dum. and Bibr., Erpt. Gen., V, p. 717, 1839. 2 spec. Locality—Honeysuckle Track, nr. Gelantipy. Mus. Nos. D 7736-7.

Genus HEMIERGIS Wagl., 1830

Hemiergis decresiense (Fitzing.), 1826

Zygnis decresiensis Fitzing., Neue Classif. Rept., p. 53, 1826. 1 spec. Locality—Honeysuckle Track, nr. Gelantipy. Mus. No. D 7733.

Genus SIAPHOS Gray, 1845.

Siaphos maccoyi L. and F., 1894

Siaphos maccoyi Lucas and Frost, Pro. Roy. Soc. Vict., (N.S.) VI, p. 85, 1894. 6 spec. Locality—Honeysuckle Track, nr. Gelantipy. Mus. Nos. D 7729-32 and D 7734-5.

MOLLUSCA

By C. J. Gabriel, Honorary Conchologist, National Museum of Victoria, and J. Hope Macpherson, B.Sc., Conchologist, National Museum of Victoria.

Land Mollusca

Gastropoda

1. Family **ACAVIDAE**
Genus HEDLEYELLA

2. Family **HELICIDAE**
Genus CHLORITIS

3. Family **RHYTIDIDAE**
Genus RHYTIDA

Family **ENDODONTIDAE**
(a) Genus CHAROPA
(b) Genus EGILODONTA
(c) Genus OREOMAVA
(d) Genus ALLODISCUS

5. Family **LAOMIDAE**
Genus PARALAOMA

6. Family **ZONITIDAE**
(a) Genus HELICARION
(b) Genus CYSTOPELTA

Introduced Land Mollusca

7. Family **LIMACIDAE**
Genus MILAX

Family **ACAVIDAE**

Genus HEDLEYELLA Iredale, 1914.

Hedleyella atomata (Gray), var. *kershawi* (Brazier).

1871. *Bulimus* (*Liparus*) *kershawi* Brazier, P.Z.S. Lond., p. 641.
1930. *Hedleyella atomata* (Gray), var. *kershawi* Brazier. Gabriel P.R.S. Vic., XLIII, Pt. 1, (N.S.), p. 66, pl. 3, figs. 1-8.

Size of Type—Length, 50·79; breadth, 28·56; alt. 25·39mm.

Aperture—Length 31·73; breadth, 15·8mm.

Type Locality—Snowy River, Gippsland, Victoria.

Observations.—This is a beautiful shell, easily the largest of our Victorian terrestrial forms, and apparently confined to the eastern portion. Consistency in shape is not apparent, as will be seen in the figures above quoted, and further examination of numerous specimens convinces us that this Victorian form should be regarded as of varietal value only. Specimens from the Snowy River area, as defined in this report, are on the whole smaller than the type.

Localities.—4 specimens (F 1671) Wombargo Creek (above 3,000 ft.); 4 specimens (F 1910) Suggan Buggan River; 8 specimens (F 1909) Honeysuckle Track, Gelantipy; 3 specimens (F 1911) Snowy River (Moon's Crossing).

Family **HELICIDAE**

Genus CHLORITIS Beck, 1837.

Chloritis victoriae (Cox).

1868. *Helix victoriae* Cox, Mon. Aust. Land Shells, p. 37, pl. 12, fig. 5.
1930. *Chloritis victoriae* (Cox). Gabriel, P.R.S. Vic., XLIII, Pt. 1, (N.S.), p. 67.

Size of Type.—Maj. diam., 15·99; min., 12·69; alt., 11·42mm.

Type Locality.—Westerport, Victoria.

Observations.—This is a very frequent and widely distributed species throughout the State, with an extension of range to King Island and Mt. Kosciusko. It is normally of a uniform brown colour and when deprived of its characteristic bristly epidermis, it alters in general appearance, and is suggestive of another species.

Localities.—17 specimens (F 1899); Honeysuckle Track, Gelantipy; 14 specimens (F 1670) Wombargo Creek.

Family **RHYTIDIDAE**

Genus RHYTIDA Albers, 1860.

Rhytida ruga (Cox).

1871. *Helix ruga* Cox, in Legrand, Coll. Mon. Tas. Land Shells, sp. 24, pl. 1, fig. 5.
1930. *Rhytida ruga* (Cox). Gabriel, P.R.S. Vic., XLIII, Pt. 1, (N.S.), p. 69.

Size of Type.—Maj. diam., 9; min., 8; alt., 3mm.

Type Locality.—Mount Wellington, Tasmania.

Observations.—One of our commoner forms enjoying a wide distribution throughout Victoria. It somewhat approaches *R. lampra* Reeve but is immediately distinguished by its finer sculpture.

Localities.—1 specimen (F 1688) Honeysuckle Track, Gelantipy; 1 specimen (F 1689) Rockbank, Wulgulmerang; 1 specimen (F 1690) Wombargo Creek (above 3,000 ft.).

Family **ENDODONTIDAE**

Genus CHAROPA Albers, 1860.

Charopa funerea (Cox).

1868. *Helix funerea* Cox, Mon. Aust. Land Shells, p. 16, pl. 3, fig. 1.

1930. *Charopa funerea* (Cox). Gabriel, P.R.S. Vic., XLIII, Pt. 1, (N.S.), p. 73.

Size of Type.—Maj. diam., 6·34; min., 5·33; alt., 2·53mm.

Type Locality.—Mudgee, New South Wales.

Observations.—A brown, closely-ribbed species, widely distributed throughout the State. It is also recorded from New South Wales and southern Queensland.

Localities.—7 specimens (F 1672) Snowy River (Moon's Crossing); 4 specimens (F 1674) Murrindal Valley, W Tree.

Charopa tamarensis (Petterd).

1879. *Helix tamarensis* Petterd, Mon. Tas. Land Shells (April), p. 30.

1930. *Charopa tamarensis* Petterd. Gabriel, P.R.S. Vic., XLIII, Pt. 1, (N.S.), p. 72.

Size of Type.—Maj. diam., 6; min., 5; alt., 2mm.

Type Locality.—Rifle butts, near Launceston, Tasmania.

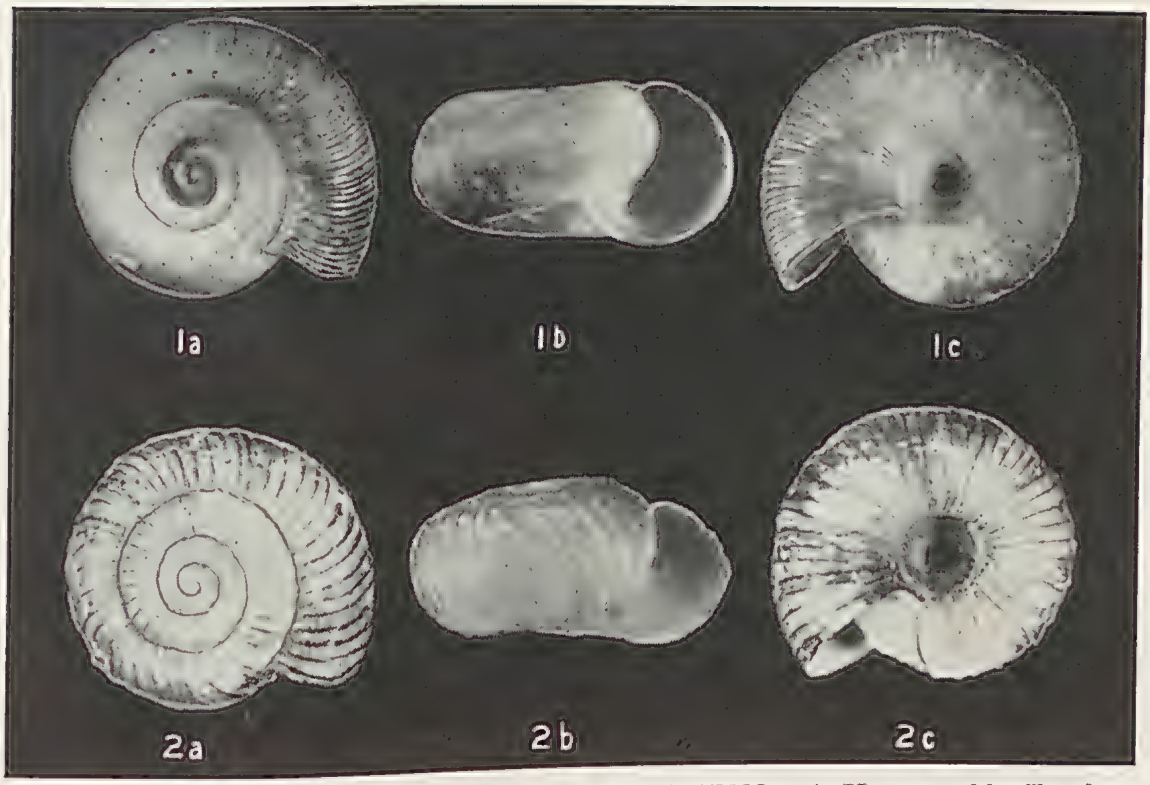
Observations.—A characteristic little species, possessing a wide umbilicus and rays of rusty-brown colour. Two specimens from the same locality vary a little in that they show radials much wider apart, but as they are alike in every other respect we regard them as variants. It has a wide distribution in Victoria and at Mt. Kosciusko Hedley records it from Wilson's Valley.

Locality.—4 specimens (F 1859) Tableland, West of Wombargo (4,500 ft.) (K. C. Rogers).

Charopa brazenori sp. nov. (Pl. 13, upper; Fig. 1.)

Shell small, discoid, whitish, translucent, thin, fragile, umbilicated. Whorls including protoconch about 4½, sculptured with numerous, equidistant, radial riblets to the number of about

The Brush-tailed Rock Wallaby, *Petrogale penicillata* Griffith, Smith and Pidgeon.



1. *Charopa brazenori* n. sp. Type Reg. No. F 17682. A Honeysuckle Track, Gelantipy.
2. *Charopa snowyensis* n. sp. Type Reg. No. F1673. A Snowy River (Moon's Crossing).

a—Upper surface; b—Side view; c—Lower surface.

Rounded boulders of granite embedded in "Porphyry"—Campbell's Nob.

130 on the last whorl. Interstices possessing fine growth-lines, reticulated by microscopic close spiral striæ. Sutures well impressed. Aperture slightly oblique, rotundly lunar. Peristome thin, sharp. Umbilicus open, about one fourth of shell's greatest diameter, exposing all the whorls, and on which may be clearly seen the radial and microscopic spiral sculpture. Inner lip with a white callus, concealing many riblets. Animal white with a dark line running from the tentacles to the mantle edge.

Size of Type.—Maj. diam., 3·3; min., 2·8; alt, 1·8mm.

Type Locality.—Honeysuckle Track, Gelantipy.

Observations.—A small shell, with a near ally in *C. ricei* Brazier. The flatness and coarser sculpture of the novelty immediately separates the two forms.

This species is dedicated to Mr. C. W. Brazenor to whom we are indebted for help in field collecting and photographs.

Type Reg. No. F 1682 A and 5 Paratypes (F 1682) in collection of National Museum of Victoria; 1 Paratype in collection of C. J. Gabriel.

Charopa snowyensis sp. nov. (Pl. 13, upper; Fig. 2).

Shell small, white, covered with light brown epidermis, subdiscoidal, umbilicated; spire nearly flat, slightly raised above the last whorl. Whorls $4\frac{1}{2}$ sculptured with fine radial ribs, numbering about 50 on the ultimate whorl which is slightly descending. Interstices striated with minute growth-lines, averaging about fifteen and crossed by spiral striæ, the latter distinctly visible above and below. Sutures inpressed. Aperture a little oblique, roundly lunate. Peristome simple, thin. Several ribs in front of aperture covered by a white callus glaze. Umbilicus wide, about one fourth of shell's greatest diameter and showing all the volutions.

Size of Type.—Maj. diam., 3·2; min., 2·8; alt., 1·6mm.

Type Locality.—Snowy River (Moon's Crossing) Victoria.

Observations.—An interesting shell which may be compared with the new species *C. jemmysensis* (these Memoirs *ante* p.). However, the consistently higher spire and narrower umbilicus together with the distinct epidermis of the species are more than sufficient grounds for separation.

Type Reg. No. F 1673 A and 5 Paratypes F 1673 B and C in collection of National Museum of Victoria; 2 Paratypes in collections of C. J. Gabriel.

Localities.—22 specimens (F 1673). Snowy River (Moon's Crossing); 2 specimens (F 1687) Suggan Buggan River.

Charopa sp. ?

Size of Type.—Maj. diam. 1·3; min., 1·1; alt. 0·6mm.
Locality.—1 specimen (F 1680) Wombargo Creek (4,000 ft.)
Observations.—One, minute, imperfect specimen.

Charopa sp. ?

Size of Type.—Maj. diam. 3·1; min. 2·7; alt., 1·5.
Locality.—1 specimen (F 1677) Snowy River (Moon's Crossing) in moss.
Observations.—One, small, brown imperfect example.

Charopa sp. ?

Size of Type—Maj. diam., 2·3; min., 2·3; alt., 1·3.
Locality.—2 specimens (F 1675) Snowy River (Moon's Crossing).
Observations.—Two examples, dark brown (juvenile).

Genus EGILODONTA Iredale, 1937.

Egilodonta bairnsdalensis (Gabriel).

1930. *Charopa bairnsdalensis* Gabriel, P.R.S. Vic., XLIII, (N.S.), pt. 1, p. 78, pl. 2, figs. 11, 12.
1937. *Egilodonta bairnsdalensis* (Gabriel), Iredale, Aust. Zool., III, p. 328.

Size of Type.—Maj. diam., 2·0; min., 1·8; alt., 0·9mm.
Type Locality.—Bairnsdale, Victoria.
Observations.—A small, beautifully sculptured species, light horn colour, and possessing an umbilicus almost half the shell's diameter. Type in the National Museum, Victoria.
Locality.—1 specimen (F 1678) Wombargo Creek (4,000 ft.).

Genus OREOMAVA Iredale, 1933.

Oreomava cannfluviatilus (Gabriel).

1929. *Allodiscus cannfluriatilus* Gabriel, Vic. Nat., XLVI, (6) p. 133, figs 1, 2, and text fig.
1930. *Id.*, P.R.S., Vic., XLIII, Pt. 1, (N.S.), p. 83.
1937. *Oreomava cannfluviatilus* (Gabriel). Iredale, Aust. Zool., VIII, p. 330.

Size of Type.—Maj. diam., 2·8; min., 2·4; alt., 1·7mm.
Type Locality.—Cann River, Victoria.
Observations.—A small shell, readily identified, the spiral liræ bordering the umbilicus providing a useful recognition mark. Type (Nat. Mus. Vic.), collected by J. Clark.
Localities.—3 specimens (F 1681) Wombargo Creek (4,000 ft.). 2 specimens (F 1905) Tableland West of Wombargo (4,500 ft.) (K. C. Rogers).

Genus ALLODISCUS Pilsbry, 1892.

Allodiscus niveus (Hedley).

1896. *Endodonta nivea* Hedley, Rec. Aust. Mus., II, p. 102, pl. 23, figs. 5-7.

Size of Type.—Maj. diam., 3·25; min., 2·75; alt., 1·5mm.

Type Locality.—Wilson's Valley, at an altitude of 4,500 ft.; Mt. Kosciusko, New South Wales.

Observations.—A small, white, thin, shining shell possessing a narrow perforation and sunken spire or as the author describes it a shallow crater, one third of the shell's major diameter. It is a distinctive form and with the excellent figures provided no difficulty should be experienced in its identification. The author remarks "This species nearly approaches *E. antialba* Beddome from Tasmania, from which its narrow umbilicus and shallow spire readily distinguishes it." Under decaying timber splendid examples were obtained, one of which exceeds the dimensions of type measuring 4·3mm. This is an interesting addition to the Victorian land shell fauna.

Locality.—8 specimens (F 1679) Wombargo Creek (4,000 ft.).

Allodiscus meracus (Cox and Hedley).

1912. *Flammulina meraca* Cox and Hedley, Mem. Nat. Mus. Melb., No. 4, p. 13, pl. 3, figs. 19-21.
1930. *Allodiscus meracus* (Cox and Hedley). Gabriel, P.R.S. Vic., XLIII, Pt. 1, (N.S.), p. 83.

Size of Type.—Maj. diam., 4; min., 3; alt., 2mm.

Type Locality.—Dandenong Ranges, Victoria.

Observations.—A small, pure white species frequently located in association with *H. subdepressa* Brazier, on many of our mountainous districts under charred and decaying timber. The animal is of a very dark colour rendering it more difficult to detect than its associate. In 1930, one of us (C.J.G.) referred to two specimens collected at Paradise Falls, near Whitfield showing a slight increase in size of the umbilicus. These are similar to the Wombargo shells and we regard them as variants of Cox and Hedley's *meracus.*

Locality.—8 specimens (F 1679) Tableland West of Wombargo (4,500 ft.), (K. C. Rogers).

Genus PARALAOMA Iredale, 1913.

Paralaoma morti (Cox)

1864. *Helix morti* Cox, Ann. Mag. Nat. Hist., (3), XIV, p. 182.
1930. *Laoma morti* (Cox). Gabriel, P.R.S. Vic., XLIII, Pt. 1, (N.S.), p. 78.
1937. *Paralaoma morti* (Cox). Iredale, Aust. Zool., VIII, Pt. 4, p. 313.

Size of Type.—Maj. diam., 2·03; min., 1·77; alt., 1·01mm.

Type Locality.—Green-oakes, Darling Point, Sydney, N.S.W.

Observations.—A small, brown species, exceedingly common throughout Victoria.

Locality.—4 specimens (F 1676) Snowy River (Moon's Crossing) in moss.

Family ZONITIDAE

Genus HELICARION Ferussac, 1821.

Helicarion cuvieri Ferussac.

1821. *Helicarion cuvieri* Ferussac, Tabl. Syst., p. 20.
1849. *Vitrina verreauxi,* Pfieffer P.Z.S., 1849, p. 132.
1862. *Vitrina verreauxi* Pfeiffer. Reeve, Conch. Icon., XIII, pl. 4, fig. 21.
1930. *Helicarion cuvieri* Ferussac. Gabriel, P.R.S. Vic., XLIII, Pt. 1, (N.S.), p. 85.
1937. *Id.,* Iredale, Aust. Zool., ix, Pt. 1, p. 7.

Size of average specimen.—Diam., 11; alt., 6·5mm.

Type Locality.—Terres Australes.

Observations.—A smooth, shining species of common occurrence throughout Victoria, and appears to prefer damp conditions under decayed timber. Reeve (*loc. cit.*) remarks "Distinguished chiefly by its narrowly produced transverse form." Its golden-yellow colour is fairly constant but specimens from Lilly Pilly Gully, Wilson's Promontory are much darker—approaching chocolate-brown.

Locality.—1 specimen (F 1893) Wombargo Creek (4,000ft.) collected on damp Southern Wollybutt hillside.

Helicarion sp. ? (aff. *H. cuvieri* Ferussac).

Size of Type.—Maj. diam., 14·0; Min., 11·0; alt., 6·0mm.

Locality.—1 specimen (F 1897) Honeysuckle Track, Gelantipy.

Observations.—One specimen taken alive showing points of difference with *H. cuvieri,* particularly as regards the animal. We are awaiting further examples to assist in our diagnosis.

Genus CYSTOPELTA Tate, 1881.

Cystopelta petterdi Tate, var. *purpurea* Davies.

1912. *Cystopelta petterdi* Tate, var. *purpurea* Davies. P.R.S. Vic. (N.S.), XXIV (2) p. 331.
1930. *Cystopelta petterdi* Tate, var. *purpurea* Davies, Gabriel, P.R.S. Vic. XLIII Pt. 1 (N.S.), p. 86.

Size of Type—Length of foot 19·5mm; length of shield 16·7mm.; depth of shield 3·75mm.

Type Locality.—Narbethong, Victoria.

Observations.—A small slug-like animal with its organs drawn into a dorsal hump as in the snails but without a shell. Living specimens pale grey, with two short darker lines on either side of the posterior end of the foot, and on the dorsal surface of the shield a few bright violet spots.

Locality.—3 specimens (F 1891) Wombargo Creek (4,000 ft.).

These slugs were collected on the wet southern slopes of the hillside to the North of Wombargo Creek. It carries open Wollybutt jungle.

Introduced Land Mollusca

Family **LIMACIDAE**

Genus MILAX Gray, 1855.

Milax gagates (Draparnaud).

1801. *Limax gagates* Draparnaud, Tabl. Moll. France, p. 100.
1930. *Milax gagates* (Draparnaud) Gabriel P.R.S. Vic. XLIII, Pt. 1 (N.S.) p. 87.

A very variable slug; black, slate grey, dark red, brown or yellowish, with dusky markings, pale underneath, acutely keeled from mantle to tail. Shell internal, a small calcareous plate.

Locality.—2 specimens (F 1895) Snowy River (Deddick Crossing).

Milax sowerbii Ferussac.

1774. *Limax marginatus* Mueller, Verm Hist. 11 p. 10.
1823. *Limax sowerbii* nobis *Ferrusac*, Hist. Nat. Moll., 11 p. 955, pl. VIII, f. 5 and 6.

Type Locality.—London, England.

A slim creamy yellow slug; white beneath; the mantle with a deep brown horse-shoe shaped line; also a pair of dark lines running from the mantle to tail. Shell a small calcareous plate.

Locality.—20 specimens (F 1896) Snowy River (Campbell's Nob). These slugs are very common in the whole of the Gelantipy area.

Fresh Water Mollusca

Gastropoda

Family 1 **LIMNAEIDAE**

(a) Genus LIMNÆA.
(b) Genus ISIDORELLA.

Lamellibranchiata

Family 1 **CYCLADIDAE**

Genus PISIDIUM

Gastropoda

Family **LIMNÆIDAE**

Genus LIMNÆA Lamarck, 1799.

Limnaea brazieri Smith.

1882. *Limnaea brazieri* Smith, Journ. Linn. Soc. Lond., Zool., XVI, p. 274, pl. 5, fig. 15.

Size of Type.—Length 9; diam., 5½; Aperture long 6; breadth 4½mm.

Type Locality.—Glebe Point, Sydney, New South Wales.

Observations.—This shell, which is an interesting addition to the Victorian fluviatile molluscs, the author describes as ovate glossy, brownish horn-colour, somewhat strongly striated longitudinally by the lines of increment, without spiral or transverse sculpture. Our identification has been fasciliated by specimens from the type locality sent to the National Museum from the Australian Museum, Sydney.

Locality.—50 specimens (F 1903) dam, Banool, Gelantipy, Victoria (A. Hodge).

Limnaea gunni Petterd.

1889. *Limnaea gunni* Petterd, P.R.S. Tas., p. 66, pl. 2, fig. 10; pl. 3, figs. 9. and 12 (animal).

1939. *Limnaea gunni* Petterd. Gabriel. Mem. Nat. Mus. Vict., XI, p. 108, pl. 1, fig. 8.

Size of Type.—Length, 7; breadth, 5·5mm.

Type Locality.—South Esk River, near Launceston, Tasmania.

Observations.—A very thin, fragile, yellowish horn-coloured shell, previously located at Tarraville.

Locality.—22 specimens (F 1904) swamp, Rockbank. These specimens were found in a natural soak on top of the soft mud between grass tussocks. 1 specimen (F 1940) Sandy Swamp, Rockbank.

Limnæa sp.

The specimens, apparently distinct from any known Victorian form, are either too immature or too fragmentary for certain diagnosis.

Locality.—13 specimens (F 1894) Little River, Rockbank.

The Little River is a clear stream with a loose boulder bottom on which the snails were crawling in about a foot to eighteen inches of water.

Genus ISIDORELLA Tate, 1896.

Isidorella newcombi (Adams and Angas).

1864. *Physa newcombi,* A. Adams and Angas, P.Z.S. Lond., 1863, p. 416.
1939. *Isidorella newcombi* Adams and Angas. Gebriel, Mem. Nat. Mus. Vic., XI., p. 117, pl. 2, fig. 22.

Size of Type.—Length, 21; breadth, 14·6mm.

Type Locality.—Ponds of Mt. Margaret, Central Australia.

Observations.—A thin, ovate-globose brownish shell with finely spirally-striated, whorls.

Locality.—6 specimens (F 1900) Banool, Gelantipy. (A. Hodge).

Isidorella newcombi Adams and Angas var. *crebreciliata* (Tenison Woods). L

1878. *Physa crebreciliata,* Tenison Woods, Trans. Roy, Soc. Vic., XIV, p. 63.
1939. *Isidorella newcombi* (Ad. and Ang.) var. *crebreciliata* (Tenison Woods), Gabriel, Mem. Nat. Mus. Vic., XI, p. 119, pl. 2, fig. 25.

Size of Type.—Length, 15; breadth, 7mm.

Type Locality.—Caulfield, Victoria.

Observations.—On this form Hedley remarks, "There are on the body-whorl about thirty-two spirals of fine ciliæ decussated by fine, close longitudinal lamellæ. The latter as in the case of *I. newcombi,* rise round the suture into a sort of ruff, or collar."

Locality.—40 specimens (F 1901) dam Rockbank; 18 specimens (F 1902) Little River; 1 specimen (F 1942) Banool, Gelantipy.

Lamellibranchiata

Family **CYCLADIDAE**

Genus PISIDIUM Pfeiffer, 1875.

Pisidium etheridgii E. A. Smith.

1882. *Pisidium etheridgii* Smith, Journ. Linn. Soc. Conch., Zool., XVI, p. 306, pl. 7, fig. 35.
1939. *Pisidium etheridgii* Smith. Gabriel, Mem. Nat. Mus. Vict., XI., p. 129, pl. 4, fig. 37.

Size of Type.—Length, 5·5; breadth, 6·5; diam., 3·5mm.

Type Locality.—Yan Yean Reservoir, Plenty District, Victoria.

Observations.—The smallest Victorian freshwater bivalve. Smith (*loc. cit.*) remarks: "Umbones rather prominent, with the young shell forming a more or less distinct apical cap. Concentric striæ very fine. Not unlike the European *P. casertanum,* but rather less inequilateral."

Locality.—5 specimens (F 1892) dam Rockbank (2,800 ft.); 17 specimens (F 1898) Sandy Swamp (4,500 ft.) Rockbank.

INSECTS AND ARACHNIDS.

By A. N. Burns, B.Sc., Entomologist, and C. Oke, Assistant Entomologist, National Museum, Melbourne.

Most of the insects collected were taken under logs and in similar situations; little winged material could be expected on account of the lateness of the season.

Order ***ORTHOPTERA***

Family **BLATTIDAE**

Genus PLATYZOSTERIA

(1) *Platyzosteria analis* Sauss.
(2) *P. brigitæ* Shaw.
(3) *P.* sp.
(4) *P. scabrella* Tepper.

Genus ONICOSOMA.

(1) *Onicosoma granicollis* Sauss.

Genus PANESTHIA.

(1) *Panesthia australis* Brunn.

Family **ACRIDIIDAE**

Genus GONIÆA.

(1) *Goniaea obscura* Sj.

Genus SCHIZOBOTHRUS.

(1) *Schizobothrus flavovittatus* Sj.

Order ***HEMIPTERA***

Family **REDUVIIDAE**

(1) *Reduviid* sp.

Family **NAUCORIDAE**

(1) *Naucorid* sp.

Order ***COLEOPTERA***

Family **CARABIDAE**

Genus EURYLYNCHUS.

(1) *Eurylynchus blagravei* Cast.

Genus PROMECODERUS.

(1) *Promecoderus inornatus* Macl.

Genus NOTONOMUS.

(1) *Notonomus Muelleri* Sl.
(2) *N. Rainbowi* Sl.

Genus NOTOPHILUS.

(1) *Notophilus laetus* Bl.

Family **DYTISCIDAE**

Genus LANCESTES.

(1) *Lancestes lanceolatus* Cl.

Genus RHANTUS.

(1) *Rhantus pulverosus* Steph.

Genus PLATYNECTES.

(1) *Platynectes decempunctatus* Fab.

Sub-order ***Polyphaga***

Family **HYDROPHILIDAE**

Genus HYDROBATICUS.

(1) *Hydrobaticus tristris* Macl.

(2) *H. australis* Blkb.

Family **PAUSSIDAE**

Genus ARTHOPTERUS.

(1) *Arthopterus westwoodi* Macl.

Family **TENEBRIONIDAE**

Genus TEREMENES.

(1) *Teremenes longipennis* Hope.

Genus CARDIOTHORAX.

(1) *Cardiothorax australis* Cart.

Genus LICINOMA.

(1) *Licinoma nitida* Pasc.

Genus ADELIUM.

(1) *Adelium porcatum* Fab.

(2) *A. licinoides* Kirby.

(3) *A. pustulosum* var. *victoriae* Blk.

(4) *A. subdepressum* Cart.

(5) *A. helmsii* Cart.

Genus BRYCOPIA.

(1) *Brycopia pilosella* Pasc.

Family **STAPHYLINIDAE**

Genus LEPTACINUS.

(1) *Leptacinus socius* Fvl.

Genus METAPONCUS.

(1) *Metaponcus luridipennis* Macl.

Genus MEDON.

(1) *Medon varicornis* Blkb.

Genus CALODERA.

(1) *Calodera abdominalis* Fvl.

Family **PSELAPHIDAE**

Genus RYBAXIS.

(1) *Rybaxis strigicollis* West.

Genus EUPINES.

(1) *Eupines globulifer* Schauf.

Genus PSELAPHUS.

(1) *Pselaphus villosus* Lea.

Genus TYRAPHUS.

(1) *Tyraphus howitti* King.

Family **SCARABÆIDAE**

Subfamily **Coprinæ**

Genus ONTHOPHAGUS.

(1) *Onthophagus pexatus* Har.

Subfamily **Melolonthinae**

Genus AUTOMALUS.

(1) *Automalus bicolor* Blkb.

Family **CERAMBYCIDAE**

Subfamily **Cerambycinae**

GENUS CERÆGIDION.

(1) *Ceraegidion horrens* Bsdv.

Family **CHRYSOMELIDAE**

Genus PAROPSIS.

(1) *Paropsis atomaria* Marsh.

Family **CURCULIONIDAE**

Subfamily **Eremninae**

Genus MANDALOTUS.

(1) *Mandalotus latebricola* Lea.
(2) *M. cordipennis* Lea.
(3) *Mandalotus* sp.

Subfamily **Cryptocorrhynchinae**

Genus DECILAUS.

(1) *Decilaus perdirus* Pasc.

Subfamily **Phalidurinae**

Genus PHALIDURA.

(1) *Phalidura elongata* Macl.

Subfamily **Tychinae**

Genus ELLESCHODES.

(1) *Elleschodes pictus* Lea.

Order ***DIPTERA***

Family **STRATIOMYIDAE**

Genus BOREOIDES.

(1) *Boreoides subulatus* Hardy.

Order *LEPIDOPTERA.*

Family **HEPIALIDAE**

Genus OXYCANUS.

(1) *Oxycanus* sp. near *sirpus;* may be new.

Family **NOTODONTIDAE**

Genus TRICHETRA.

(1) *Trichetra sparshalli* Curt.

Family **BOARMIIDAE**

Genus STRATHMORRHOPA.

(1) *Strathmorrhopa porphyrinaria* Gn.

Order ***ARACHNIDA***

Genus ATRAX.

Family **AVARICULARIDAE**

(1) *Atrax* sp. nov.

Amongst the Coleoptera one small species of weevil taken from sifted moss probably belongs to a new genus. In the Lepidoptera, two specimens of a Hepialid moth also appear to be new; they closely resemble a well known Victoria species, *Oxycanus sirpus* Tind., but examination of the genitalia shows them to be quite distinct.

A fine large Trapdoor Spider with about 50 young ones is new, and belongs to the typical genus *Atrax*.

RECORDS OF ONCHIDIIDAE (MOLLUSCA, GASTROPODA) FROM VICTORIA.

By J. Hope Macpherson B.Sc., Conchologist, National Museum of Victoria.

(Received for publication July 7, 1947).

Plate 14.

These notes record two species of Onchidiidæ from the Victorian coast, and give some observations regarding their habitat and habits.

The family Onchidiidæ is chiefly a tropical and sub-tropical one (Pacific and Indian Oceans), though a few species straggle into the temperate zones of both the Northern and Southern Hemispheres. From the latter, six species have been recorded from New Zealand by Powell (3), one of which, *Onchidella patelloides* (Q. and G.) has also been taken in Tasmania by Bretnall (1). Until recently (2), no records of Victorian Onchidiidæ had been published, but within the last two years, the National Museum has collected examples of two species within the State.

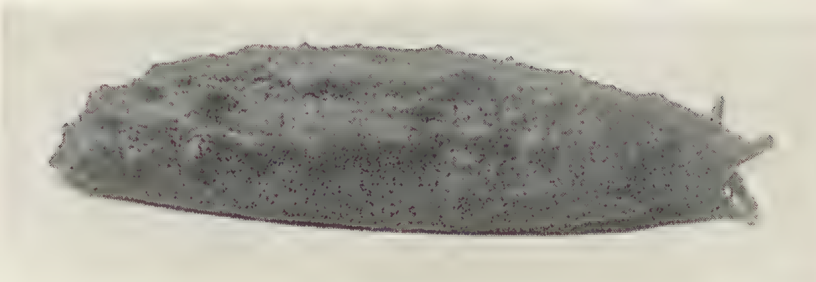
Onchidina australis Semper, 1882.

Onchidina australis Semper. Reis. im Arch. Phil., III. Landmoll., VI., 1882, p. 287.

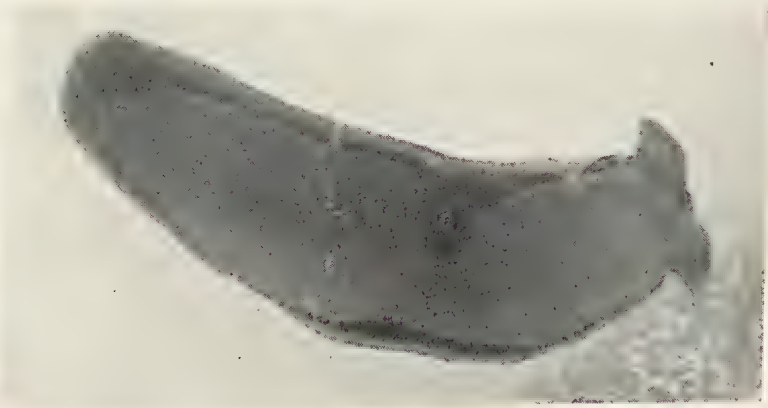
In February 1946, specimens of this species were collected by the author at Wingan Inlet, East Gippsland. The upper shores of the Inlet are estuarine mud flats with typical flora. The *Onchidina* were found about thirty feet above high tide mark feeding on *Tetragonia expansa* Murr.; the colony consisted of some hundreds of individuals. They were strictly nocturnal, feeding only at night, retiring during the day under bark, driftwood, or other debris.

On a second visit made to the Inlet in June 1946 it was found that the *Tetragonia* had died down, and that no *Onchidina* were in its immediate vicinity. However, on turning over partly submerged logs on adjacent open mud flats, the animals were seen to be hibernating on the damp undersides of the logs or burrowing into the mud beneath.

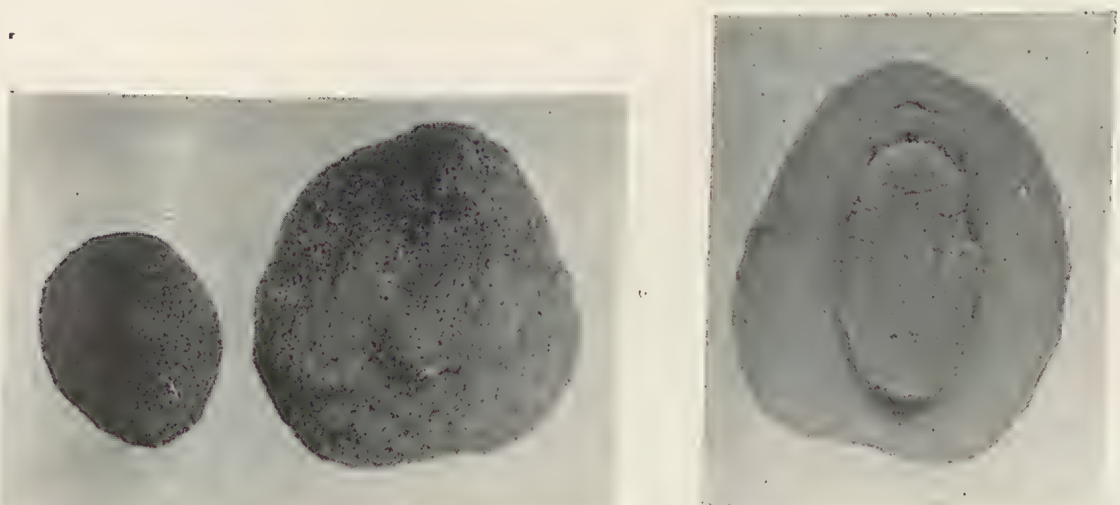
Specimens kept in a vivarium at the National Museum are strictly nocturnal, retiring to their burrows or under debris during the day. This confirms the field observations noted above.



Onchidina australis Semper. Wingan Inlet, Victoria.
Dorsal view x $1\frac{1}{2}$.



Onchidina australis Semper. Wingan Inlet, Victoria.
Ventral view x $1\frac{1}{2}$.



Onchidella patelloides (Q. and G.). San Remo, Westernport, Victoria.
Dorsal view x $1\frac{1}{2}$. (Left.)
Ventral view x $1\frac{1}{2}$. (Right.)

Onchidella patelloides (Q. and G., 1832).

Onchidium patelloides Quoy and Gaimard, *Voy. de l'Astrolabe.* Zool. II, p. 212, 1832.

This species has recently been recorded from Lorne, Victoria, by Dakin (2). The Museum has specimens collected by the author from Point Addis and San Remo, and from Mrs. G. Van Rompaey, who collected them at Wye River (also on the Otway Coast), and at San Remo, in 1941.

Onchidella patelloides is marine and differs from *Onchidina* in respect to its habitat. It is a rock dweller, found attached to the underside of loose rock, and in crevices of rocky shore platforms. In April, the Point Addis specimens were found at low tide mark, which suggests that they are submerged always at that time of the year.

Some observations on the anatomy of these two species will be described in a later paper.

References.

1. Bretnall, R. W. Onchidiidæ from Australia and the South-Western Pacific Islands. Rec. Aust. Mus. XII, pp. 303-328, 1919.
2. Dakin, W. J. The True Sea-slug—Onchidium. Aust. Mus. Mag. IV, No. 4, pp. 141-144, 1947.
3. Powell, A. W. B. The Shellfish of New Zealand, p. 97, 1946.

A NEW HARVESTMAN OF THE SUBFAMILY LIOBUNINAE FROM AUSTRALIA

By R. R. Forster, Dominion Museum, Wellington, N.Z.

(Received for publication August 15, 1947.)

Figs. 1-9

The species described below is the first record of the subfamily Liobuninæ from Australia, the distribution of this subfamily having previously been limited to the northern areas of the world. It seems probable however, that when the Opilionid fauna is more completely known, it will prove to be well represented in Australia. The species described is placed in the genus *Nelima* Roewer. This genus has a wide distribution, including Europe, Asia and North Africa. The fusion of a number of tergites in the male, as is seen in *N. dunni* n.sp., is of common occurrence throughout the Liobuninæ.

Order ***OPILIONES***

Sub-order ***Palpatores Thorell***

Family **PHALANGIIDÆ** Simon

Subfamily **Liobuninæ** Banks.

Genus NELIMA Roewer.

Nelima dunni n. sp.

Female.

Colour. General colour of dorsal surface of body light chocolate-brown, but broken up by numerous small, closely spaced silvery-white splotches. Tergite 5 silvery white, without brown pigment. On the anterior portion along the middle line of each tergite is a reddish brown area, behind each such area the brown pigment is not as dense as in remainder of tergite, giving the appearance of a median longitudinal pale band broken by the reddish brown areas. Cephalothorax with a dark brown area at both the anterior and posterior corner. Eye-mound white along median line, dark brown laterally, eyes black. Entire ventral surface including coxæ opaque silvery-white. Legs and pedipalps light-brown.

Body. Entire dorsal surface very finely granulated. Eye mound not as high as wide, sub-spherical, set its own diameter from the anterior margin of the cephalothorax, with a deep median longitudinal groove, armed with a longitudinal row of small spines above each eye.

Cephalothorax divided behind eye mound by two transverse grooves which do not reach the lateral margin. Stink gland openings clearly visible on lateral margin of cephalothorax above coxa I. Anterior margin with a median indentation and lateral margin with three further indentations enclosing coxæ I, II and III, respectively.

Tergites not fused into a scute but clearly separated by transverse grooves which do not reach the sides. Sternites fused, segmentation only faintly visible; smooth, except for a scattered number of small black setæ. Genital operculum uniform, extending to posterior margin of coxa II.

Maxillary lobes of coxa II directed across the body anterior to the genital operculum, forming with each other a nearly straight line.

Legs. Coxæ smooth, except for scattered small black setæ; without anterior or posterior rows of granules. Trochantera smooth except for few small black setæ. Femora without nodules, closely covered with longitudinal rows of small black spines. Femur II relatively long and slender. Tibiæ, metatarsi and tarsi without spines. Metatarsi I-IV respectively with 2 . 5 . 1 . 4 false articulations.

Tarsal segments 45 . 71 . 35 . 35.

Cheliceræ. Short, basal segment below with strong forwardly-directed spine at one-third. Both segments sparsely clothed with a number of short setæ. Fixed finger longer than movable finger; cutting edges toothed as in Fig. 3.

Pedipalpi. All segments clothed with short setæ. Tarsus with a number of long apically situated setæ. Tarsal claw strong, armed below with a single line of five strong teeth. (Fig. 7).

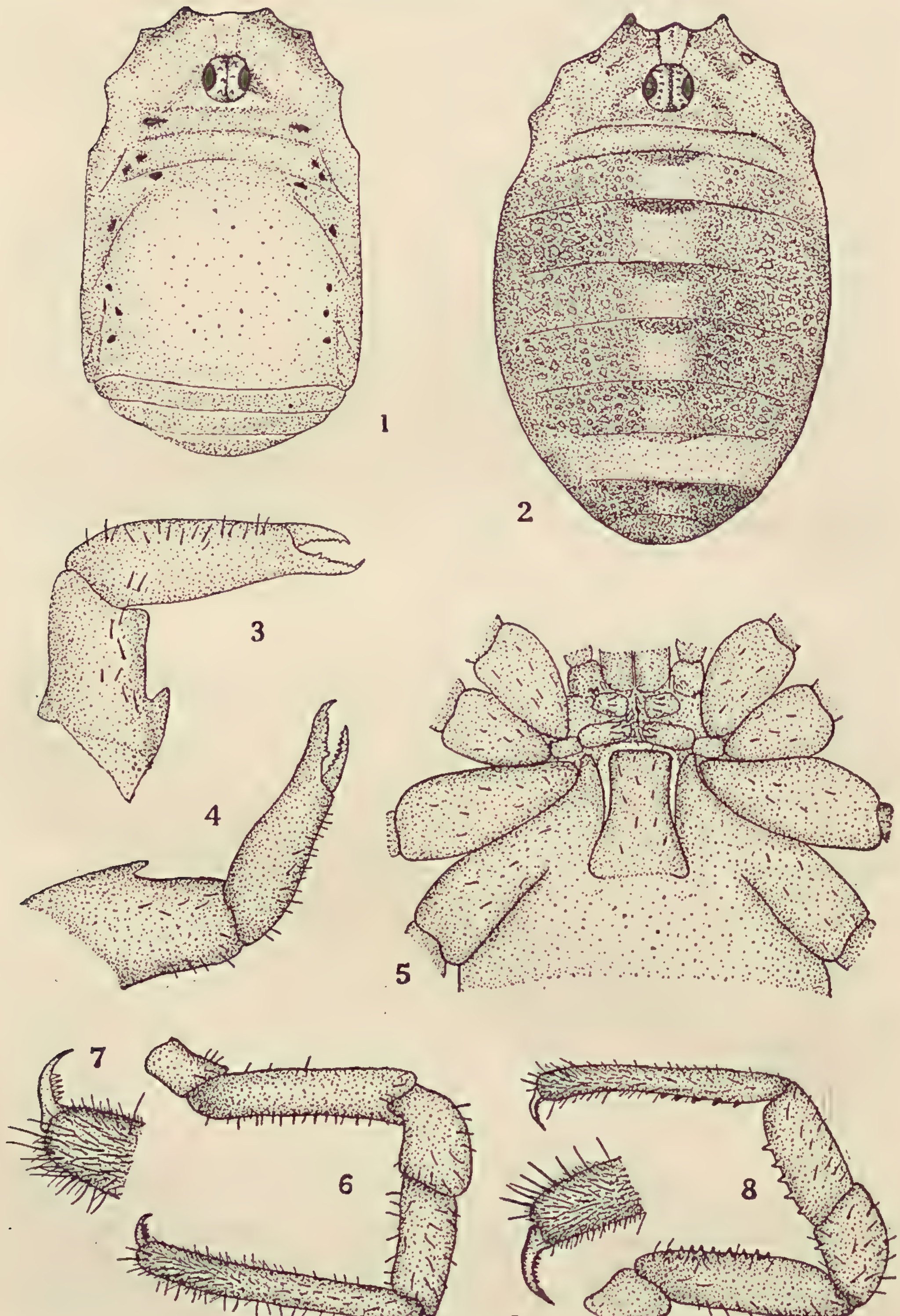
Measurements in mms. Body: Length 5·9; Width, 3·3.

	Cox.	Troch.	Fem.	Pat.	Tib.	Met.	Tars.	Total
Leg I	1·6	·25	2·9	·85	2·65	2·5	5·75	16·50
Leg II	1·25	·225	5·0	·85	5·5	2·7	14·5	30·025
Leg III	1·075	·3	2·75	·95	2·55	1·0	6·0	14·625
Leg IV	1·1	·25	4·35	1·0	3·6	3·0	9·0	22·30
Pedipalp		·25	·85	·35	·5		1·1	3·05

Chelicerae—Basal 1·0, Second 2·3. Total .. .. 3·3

Male.

Colour. Uniform yellowish-brown. Anterior corners of cephalothorax dark-brown. In some specimens the lateral dorsal margin of the abdomen is darker brown. Ventral surface yellowish-white with a few silverish blotches on the sternites. Pedipalp white. Chelicera uniformly brown. Legs light-brown proximally but darkening distally. Eye mound white along the median line, dark brown laterally—eyes black.



FIGS. 1-9

Body. Eye mound shape and disposition as in female. Entire dorsal surface finely granulated. Cephalothorax divided behind the eye mound by two deep transverse grooves which nearly exend to the sides. Anterior median indentation encloses cheliceræ, three lateral indentations enclose respectively coxæ I, II and III.

Tergites I-V fused into a hard scute, segmentation not visible. Tergites VI-VIII free. Sternites smooth, not granulated, clearly divided by transverse grooves.

Genital operculum widening distally and extending to the posterior margin of coxa I. Maxillary lobes as in female.

Legs. As in female but metatarsi I-IV respectively with 3 . 4 . 1 and 3 false articulations.

Cheliceræ. As in female but second segment more slender.

Pedipalpi. Femur, patella, tibia and proximal half of tarsus armed below with strong teeth (Fig. 8). Otherwise as in female.

Tarsal claw strong, armed below with single row of six small teeth (Fig. 9).

Measurements in mms. Body: Length, 3·25; Width, 2·1.

	Cox.	Troch.	Fem.	Pat.	Tib.	Met.	Tars.	Total
Leg I	1·0	·2	2·55	·6	2·65	2·7	5·5	15·2
Leg II	·85	·25	4·5	·85	4·75	3·0	8·75	22·95
Leg III	1·1	·25	2·85	·65	2·15	2·1	5·0	14·1
Leg IV	1·2	·2	4·15	·75	2·8	3·5	6·75	19·35
Pedipalp		·25	·75	·35	·5		1·0	2·85

Chelicerae—Basal ·75, Second 1·5. Total .. .. 2·25

Type. Male and Female type specimens deposited in collection of Australian Museum, Sydney.

Paratypes. Collection National Museum of Victoria, and Tube 2/62 Dominion Museum Coll., Wellington, N.Z.

Locality. The above species is apparently very common in and around Melbourne. The first specimens were received from Carnegie (collected by Mr. R. A. Dunn, after whom I have the pleasure of naming this species), where they were found in large numbers in a garden. Further records are Hampton (A. J. Swaby), and West Brunswick (J. Ros Garnet).

Figs. 1-9. *Nelima dunni* n. sp.
Fig. 1. Dorsal view of body of Male. Appendages omitted.
Fig. 2. Dorsal view of body of Female. Appendages omitted.
Fig. 3. Chelicera of Female.
Fig. 4. Chelicera of Male.
Fig. 5. Ventral aspect of the anterior portion of the body of Female.
Fig. 6. Pedipalp of Female.
Fig. 7. Enlargement of the distal portion of the tarsus in Fig. 6.
Fig. 8. Pedipalp of the Male.
Fig. 9. Enlargement of the distal portion of the tarsus in Fig. 8.

DESCRIPTION OF A NEW SPECIES OF CASEMOTH (LEPIDOPTERA, PSYCHIDAE)

By Charles G. Oke

National Museum of Victoria

Plate XV, Figs. 1-8

The family Psychidae is fairly well represented in Australia, some of the species being very common and widely spread, but fourteen of the species are, according to Turner's list[1], only known from single specimens. Very little is known about the biology of Australian species, but even so, there can be no excuse for Meyrick and Lower in 1907[2], or Turner in 1945[1], stating that the females are legless. Westwood in 1845[3] figures several females showing their legs.

Plutorectis caespitosae sp. nov.

♂ 22-24 mm. across wings. Derm of body black, nitid, normally concealed by long dense clothing which is mostly fuscous brown, but on head and prothorax becoming a pale ochreous and very sericeus; anterior margin of wings blackish, elsewhere the scales on wings cinereus; cilia cinereus, with a golden tint.

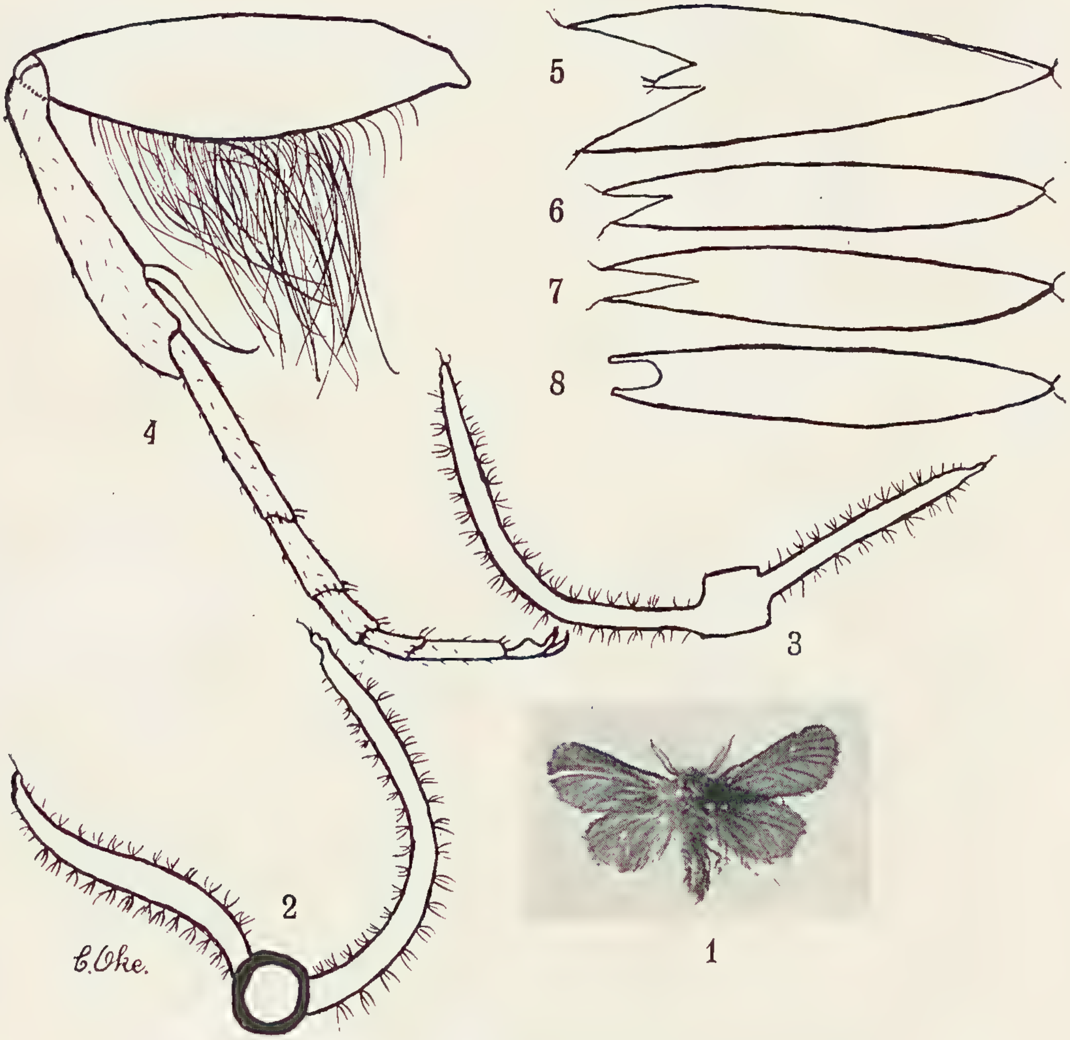
Eyes small. Antennal pectinations 7; stem dingy ochreous, pectinations fuscous. Forewings with costa straight almost to apex, apex rounded; termen rounded. Hind wings with apex lightly rounded; termen rather strongly rounded.

♀ 14 mm. long. Much degraded. Legs appearing much like those of a larva. Head apparently without appendages.

Habitat.—Victoria: Bogong High Plains in January (Miss L. White). Type Locality: Mt. Hotham (C. Oke); New South Wales, Mt. Kosciusko (Amos Williams in Dec., C. E. Chadwick 313-48). Feeding on *Poa caespitosa* G. Forst.

Type ♂ and Allotype ♀ in collections of National Museum of Victoria.

Fairly close to *P. capnaea* Turn. but differs in being more robust, with the wings narrower and, especially the hind wings, not so strongly bowed on the termen. The colour is paler, and the cilia is not dark fuscous. The antennal pectinations are about 1½ wider. Also the scales are different: most of the scales on the



1. *Plutorectis caespitosa*, sp. nov.
2. Antennal segment—through antenna.
3. " " —from above.
4. Portion of front leg, to show tarsus.
5. Scale from fore wing, near costa.

6 and 7. Main types of scales on wings.

8. Scale from *P. capnaea* Turn.

wings have an acute V-shaped notch, as against those of *capnaea* which are distinctly U-shaped.

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OBITUARY.

James Andrew Kershaw, Director, National Museum of Victoria, 1929-1931.

The passing of James Andrew Kershaw, Director of the National Museum of Victoria from 1929 to 1931, not only terminates the long association of the Kershaw family with science in Victoria, but breaks a link with such pioneers as Sir Frederick McCoy, Baron von Mueller, Dr. Alfred Howitt, and others who laid the foundations for modern scientific research in Australia.

James Kershaw was born on April 13, 1866, at Fitzroy, Victoria, educated at the Alma Road State School and the Grammar School, East Street, St. Kilda, and appointed to the staff of the National Museum by Sir Frederick McCoy on October 1, 1883. His father, William Kershaw, had been a member of the staff since 1856, when he and Henry Edwards, the well-known actor, were appointed as Lepidopterists. The period of young Kershaw's training coincided with the scientific revival of the closing decades of last century—a revival brought about by the publicaion by McCoy of his *Prodromus of the Zoology of Victoria.* That period might well be called the Taxonomic Period, for, during it, scientific work consisted chiefly of the description of genera and species.

After the death of McCoy in May 1899, the Museum was moved from the University grounds to its present site, and Sir W. Baldwin Spencer became its Honorary Director. He resigned in 1929, and James Kershaw then became Director. On his retirement in 1931, Kershaw was appointed Honorary Curator in Zoology, interesting himself in all matters connected with Zoology, and particularly in the groups of which he was a specialist. He retained this interest to the end—only a few minutes before he died on February 16, 1946, he had been discussing with one of the younger school a matter of common scientific interest.

He was keenly interested in the Field Naturalists' Club of Victoria, and his papers in its journal cover a wide range of subjects. He took a prominent part in securing the permanent reservation of Wilson's Promontory as a National Park and a sanctuary for the preservation of the native fauna and flora. He was Honorary Secretary to the Committee of Management continuously from its inception in 1908 to 1946. He became a member of the Royal Society of Victoria in 1900, a member of its Council in 1902, and

The late James Andrew Kershaw
Director, 1929-1931

its President in 1918. He was Honorary Secretary of that Society from 1920 to 1923, appointed a Trustee in 1922, and was Honorary Librarian from 1924 to 1925. In 1934, he was elected Vice-President of the Zoological Section of the Australian and New Zealand Association for the Advancement of Science. From an early date, he had been a Fellow of the Entomological Society of London. In 1927, he was elected a Corresponding Member of the Zoological Society of London.

It is to be expected that one who had led such an active life would have travelled far. In 1908, he accompanied the Royal Australian Ornithological Union's expedition to Bass Strait—in 1909, he again visited the Bass Strait Islands; in 1913, he journeyed with Dr. MacGillivray and his son to Lloyd Bay, Queensland, to examine the Barrier Reef; in 1911, he investigated the life habits of the Platypus in the Hopkins River, Victoria; and, in 1921, visited, with J. G. Davidson, Ooldea in Western Australia, where his interests were ethnology and general zoology.

Although James Kershaw was habitually kind and urbane, he could be, when occasion demanded, strong and forceful. Those who worked with him esteemed him for his sincerity and singleness of purpose; the advancement of science was always his aim, and he subserved personal ambition to achieve it. Truth was the watchword throughout his simple life—he stood and fought for his convictions.

—R. A. K.

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